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

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

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NATURE

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WASTE-PAPER AND PAPER-WASTE.

The Recovery and Re-manufacture of Waste-paper: A Practical Treatise. By J. Strachan. Pp. vi+158. (Aberdeen: The Albany Press, 1918.) Price 12*s*. 6*d*. net.

ONCE upon a time certain of the peradventurous amongst the Scandinavian folk, perceiving that the countries affected to more intensive civilisation demanded much paper and raw material therefor, saw and seized the opportunity for conversion of the chief but perishable glory of their incomparable landscapes, by way of paper *et similia,* into the imperishable equivalent of gold!

Thus it has come about that millions of tons of coniferous wood are now represented by equivalent ounces of the "heavy" yellow metal or values so expressed, and the primary paper-making industry is dependent upon the pine forests of the world. It has also come about that "waste-paper," a byword of the old order, and the concern primarily of scavengers, has taken a strong, if secondary, position in the new order of industrial values, and of sufficient importance fully to justify the publication of the manual before us. The author, in his short "Introduction," puts the matter to be treated in its exact perspective relative to the primary industry of paper-making, and his treatment of the subject in 150 pages of text is lucid, comprehensive, and designedly "practical." This is as it should be, seeing that the re-manufacture of papers and boards involves no technical or scientific principles outside those of the primary manufacture. At the same time, under the author's treatment the volume is a valuable commentary upon and further elucidation not only of the primary manufacture in relation to principles, but also of the paper trade in relation to the uses and values of its products.

The latter is the subject-matter of the very "readable" part i., which deals with the collection or recovery of old papers, classification, grading, and valuation. Part ii. deals with re-manufacture in three sub-sections, (*a*) mechanical treatment, (*b*) chemical treatment for removal of ink and colour, and (*c*) "Miscellaneous," which concerns the manipulation of waste-paper stock and mill control.

As stated, these sections involve a technically critical appreciation of the standard mill operations and their quantitative bases—that is, in relation to fuel and water consumption and yield—and, therefore, any student of technology might usefully read these as complementary to the study of an ordinary text-book dealing rather with principles.

One point we note. While giving full attention to loss of material in working up, and classifying these losses in terms of "loading," "short fibres," "sizing," and ink substances, the author omits to note a rather important factor of loss. It is a general experience conformable with the chemistry of cellulose and ligno-cellulose that successive working involves progressive degradation of material, both into water-soluble and alkali-soluble compounds. We should doubt, therefore, whether the percentage figures which the author gives would be found to hold, seeing that this factor of loss is ignored. Generally speaking, this invisible loss is one difficult of control, and, even in the best-regulated mills, can only be estimated to a certain degree of approximation. It is, however, a very important factor.

Lastly, the author deserves a compliment for the trouble he has taken in putting out the book on a representative paper made from old—that is, re-worked—papers, and for setting out the data of its composition and qualities in full technical terms in his appendix to chap. xxv.

One word in regard to Mr. Hall Caine's preface. He considers the British paper-maker "receptive of ideas," and so he is; but conversion of ideas into effective, industrial potentials is, we suggest, quite another order of "idea"—to use his word. We should say that the British paper-makers are quite capable of much bigger things than they have ever done, but we think they will have to undergo a certain discipline of conversion, and forget a good deal of interior competitive struggle, and of the outlook connoted thereby, before they qualify for the premier position in the world's markets.

THE CONSTITUTION OF COAL.

Monograph on the Constitution of Coal. By Dr. M. C. Stopes and Dr. R. V. Wheeler. (Department of Scientific and Industrial Research.) Pp. 58 + plates iii. (London: H.M.S.O., 1918.) Price 2*s*. net.

IT is not too much to say that this monograph forms the most important contribution to our knowledge of what coal is, that has yet appeared; the problem has been tackled in the right spirit and by workers with the right kind of experience—namely, by a palæobotanist and a chemist working in conjunction. They themselves define the object of their research as an attempt "to discover what the present actual structure of a bituminous coal most usually is," and they further define what they understand by coal in the following words: "Ordinary coal is a compact stratified mass of 'mummified' plants (which have in part suffered arrested decay to varying degrees of completeness), free from all save a very low percentage of other matter." They themselves admit that this definition is not satisfactory; in particular it suffers from lack of precision, as much depends upon the sense in which the words "very low percentage" are used; it evidently includes lignite, which is perhaps intentional, but it also must include peat, which it was probably intended to exclude.

The monograph naturally falls into two main parts, dealing respectively with the chemical and the structural aspect of coal. The former discusses in much detail the composition of the various component parts that have been more or less completely identified, and relies mainly upon its division into two distinct types of compounds, distinguished as the "cellulosic" and the "resinic," the distinction being based essentially upon the solubility of the latter in pyridine, first discovered by Bedson.

In the latter portion much weight is given to the work of Lomax, which showed that ordinary bituminous coal is a humic accumulation in which, not chiefly wood, but leaves, twigs, fructifications, and other plant fragments preponderate, the term "humic" being used to indicate that the accumulation consisted of the largely undecayed mixed organs of plants. The various distinguishable plant remains are described and discussed, the most important being the woody cells, bark, including cork cells, cuticle, spore-coats and spores, seeds, and soft-walled tissue; it is shown that, with the exception of resin, the cell contents of the plants are but imperfectly preserved in coal.

The authors summarise their researches by stating their opinion that coal consists essentially of a conglomerate of morphologically organised plant tissues, of plant substances devoid of morphological organisation, of the comminuted degradation products of both of these, and of "ulmins" produced therefrom. But it may fairly be said that the value of the work lies not only in the results already attained, but also in the numerous indications that it affords of the directions along which future researches upon this highly complex subject should be conducted. It is to be regretted that the printing has been very badly done, and that numerous clerical errors have been allowed to escape the proof-readers.

H. LOUIS.

ANALYSIS AND GEOMETRY.

(1) *Elementary Mathematical Analysis.* By Prof. J. W. Young and F. M. Morgan. Pp. xii + 548. (New York: The Macmillan Co., 1917.) Price 11*s*. net.

(2) *A Course of Pure Geometry, containing a Complete Geometrical Treatment of the Properties of the Conic Sections.* By the Rev. Dr. E. H. Askwith. New edition. Pp. xi + 284. (Cambridge: At the University Press, 1917.) Price 7*s*. 6*d*. net.

(1) THE aim of Messrs. Young and Morgan is very clearly explained in their preface. Their book is intended for first-year students in universities and colleges, and, without in any way neglecting practical methods and applications, they have properly laid stress upon fundamental ideas such as "function," "continuity," and so on. Thus the student is prepared in due time for more abstract and delicate theories, and preserved from the risk of becoming a mere calculating-machine.

The contents of the book are arranged in five parts. The first is introductory; it deals with the idea of a function and its geometrical representation, and gives a sketch of the theory of rational operations in algebra. Part ii. considers elementary functions, including the simply periodic ones; it also gives a chapter on computation, in which there is an account of the slide rule, and concludes with a chapter on implicit quadratic functions. Part iii. contains the elements of analytical geometry as applied to the straight line, circle, and conic sections. Part iv. comprises chapters on algebraic manipulation, tactic, the binomial theorem, complex numbers, polynomials, theory of equations, and determinants. Part v. deals with functions of two variables, and gives the elements of analytical solid geometry. Finally, there are a set of useful tables, and a detachable page from which a rudimentary slide rule can be constructed.

The present reviewer has lately been giving lectures on similar, not to say identical, lines; the agreement in aim, choice of topics, and extent of treatment has been practically complete. It is an encouragement to find one's ideas of a suitable elementary college course so independently and strikingly confirmed. We believe that treatises of this kind will greatly help to establish a right system of teaching mathematics, not only in colleges, but also in schools, where antiquated methods are still too prevalent.

There is one omission in the book which is regrettable; the authors do not discuss the theory of *dimensions*. This is a much more important matter than it might be thought, especially when the student works geometrical exercises with numerical coefficients, so that the dimensions are partly latent. Far too often even an honours student fails to note that his answer must be wrong, because it does not satisfy the test of dimensions; and it is needless to emphasise the value of the theory in physics.

Typographically the book is all that could be desired, except that we should have preferred old-face figures in the tables. The diagrams are numerous, attractive, and well printed.

(2) The new edition of Dr. Askwith's elegant work differs from its predecessor mainly in defining the conic sections in the Greek way as sections of a cone. The earlier chapters (i.–viii.) on the triangle, circle, cross-ratios, etc., make this method easy, with one notable exception; unless we discuss complex points and lines by a purely geometrical method (such as that of v. Staudt), we are not justified in treating every figure consisting of a conic and a line as being projectively equivalent to a figure consisting of a circle and a line. This is the weak point of Dr. Askwith's book; it is not clear whether he is appealing, in the last resort, to algebra, or relying upon the exploded "principle of continuity." In other respects the treatise fully deserves the favourable reception which it has obtained.

G. B. M.

OUR BOOKSHELF.

Association: A Story of Man for Boys and Girls. By Edward B. Cumberland. Pp. 32. (Published by the author at "Le Chalet," Penn, Bucks., 1918.) Price 2*s*.

FOR nearly thirty years Mr. Cumberland has been headmaster of William Ellis School at Gospel Oak, and in convinced obedience to the founder's testament has been (since 1889) teaching "social science" to boys of ages from eight to eighteen—a remarkable record of pioneer work on lines which are sure to be widely followed in the near future. In other ways, too, with its early physics laboratory (1890) and its specially built geography room, the school has been in the front line, and we would heartily congratulate Mr. Cumberland on what he has achieved in spite of conditions often far from encouraging. He has expressed some of his ideals in an interesting little book which he calls "Association." The title refers to the author's reasoned belief that one of the factors of human progress has been association, co-ordination, the multiplying of inter-relations. He illustrates this in a retrospect of the ascent of man, and by showing how the individual finds himself and realises himself, both in body and mind, as an active social person.

The booklet seems to us better suited for adults than for boys and girls, for it is very tersely written. We cannot even refer to the many wise things that are said about home and school, work and play, town and country, civics and Nature-study; but the two dominant ideas are: (1) that "knowledge of Earth and its story helps to make man fitter for life on it, and also to raise him above it"; and (2) that the open secret of progress is to enter into more and more complex associations for noble ends, rising from school and family to community and city, and from nation to humanity. The booklet is an intensely personal document, revealing a fine purpose. There is a tiny fly in the ointment in the suggestion (on page 9) that "creatures that crawl" should be regarded with disgust.

Memoir of John Michell, M.A., B.D., F.R.S. By Sir Archibald Geikie. Pp. 107. (Cambridge: At the University Press, 1918.)

SIR ARCHIBALD GEIKIE has done a further service to British science in reviving the memory of John Michell, and in directing attention to his work in various fields. Geologists are familiar with Michell's name in connection with Jurassic strata, and especially with the "Lyas" that he traced from Somerset to Lincolnshire. It is unfortunate that this ancient quarryman's term should suggest, in its modern form, a pseudo-classical origin. Michell, after his retirement from the rectory of St. Botolph's, Cambridge, and from his brief tenure of the Woodwardian professorship of geology, continued, as rector of Thornhill, "those important investigations in physics and astronomy with which his name will always be associated." He died in 1793, before the experiment that he had designed for determining the earth's density could be carried out; but his apparatus came, through Wollaston, into the hands of his friend and correspondent Cavendish, who improved it in detail, and ungrudgingly acknowledged Michell as its originator. A long and interesting letter from Michell to Cavendish on the strata near Grantham is here published for the first time. In his frequent journeys from Thornhill to London he made observations at his halting-places, such as Greetham on the old North Road, and one feels that he would have hailed the work of his successor, William Smith, as confirming much that he had seen. In 1760, while still at Cambridge, he contributed a paper on earthquakes to the Royal Society, in which he urged that the initial shock is propagated by wave-motion through the earth.

This admirably printed and attractive work raises pleasant memories of the times when the "learned leisure" of our country clergy was often devoted to scientific culture. The divorce of clerical duties from collegiate fellowships, however desirable on both sides, has undoubtedly reduced the endowments of research.

G. A. J. C.

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.]*

German Naturalists and Nomenclature.

I TRUST that the great majority of naturalists will read with approval the following sentence in Sir George Hampson's paper on "Pyralidæ," published in the Proceedings of the Zoological Society, 1918 (p. 55):—"No quotations from German authors published since August, 1914, are included. 'Hostes humani generis.'"

I have heard it argued that as we owe much to the industrious researches of German naturalists in the past, it would be discourteous to show any prejudice against accepting their assistance in the future towards that extension of knowledge which we all desire.

It may be remembered by those who were present at the meeting of the International Zoological Congress at Monaco in March, 1913, how persistently the representatives of German scientific societies endeavoured on that occasion to dominate the discussions, especially on the subject of the rules of nomenclature, and insisted that the names habitually employed in Germany should receive the sanction of long usage, to the exclusion of all attempts to trace out the literary history of each species and to preserve for it the name bestowed by the first author who described or figured it. The attempt was one which, had it been successful, would have obliged the naturalists of other countries to accept German nomenclature and place themselves thus far unreservedly under German regulations and restrictions. In the Catalogue of Lepidoptera, published in 1871 by Staudinger and Wocke, precedence is improperly but deliberately assigned to German names in preference to earlier ones given by French authors.

Now, as to the question of discourtesy, what will be the position at some future Zoological Congress? Are American, English, French, or Italian naturalists to be expected to meet Germans and to join them in friendly discussion on the various questions that may arise? Considering that before the war every man, woman, and child in Germany, with scarcely an exception, was intent upon war, as has been amply demonstrated by the evidence of innumerable witnesses, it is impossible to dissociate the mental attitude of the population of that country, by no means excepting the highly educated and scientific classes, from the world-conquering aspirations of their rulers, or from the barbarous atrocities committed by them in pursuit of that national ideal. A conspicuous instance is that of a certain learned professor with whom I was on terms of friendship, who was honoured by the Universities of Liverpool and Dublin, and delivered lectures in London under the auspices of the London University, turning out eventually to be a German spy engaged in fomenting rebellion in Ireland and antagonism to England and her Allies in the United States. If an individual in any community commits murder or robbery, or is even plausibly suspected of swindling or cheating at cards, the unavoidable and universally recognised penalty is that no man with a grain of self-respect will ever again associate with him, shake his hand, or converse with him in friendship.

Let us trust that for the next twenty years at least all Germans will be relegated to the category of persons with whom honest men will decline to have any dealings.

It should be fully understood that this is no measure of vengeance. We do not honour thieves by vows of vengeance; we desire to punish them. Any German who may be permitted to attend an international zoological congress in the near future should be made to feel extremely uncomfortable by the urgent necessity of at least partial *camouflage*.

If Sir George Hampson's suggestion by example should be adopted and followed, it could add but a small measure to the punishment which must inevitably form part of any conditions that will be attached to a public peace when granted by dictation, not by negotiation, to the offending nation.

None but a German would use the German language by preference for scientific descriptions of species or genera; thus any inconvenience that might arise from a general refusal on the part of others to accept descriptions worded in German could fall only upon those who have inflicted far more than mere inconvenience upon the world beyond them.

To those Germans, if any there be, who are honestly well disposed, and who put the interests of science before the greed for world-domination, it can be no hardship to publish their descriptions in the English or French language, with which the great majority of their scientific workers are more or less intimately acquainted.

Inestimable damage has been done during the war to historical monuments and priceless works of art. The Germans in Italy were found to have instituted a complete organisation on the Austrian front for securing valuable pillage in the course of the expected advance on Venice; fourgons, under the charge of specially appointed officers with adequate staff, were in readiness to convey to Germany the pick of the art treasures which they believed they would find at their mercy. Collections in various branches of natural history have suffered damage or destruction among other objects. In Russia the paid agents of Germany have brought about, or at least connived at, the wanton destruction of treasures innumerable; some of the finest entomological collections in the world were in Russia, in Belgium, and in Rumania. I would urge that it is the plain duty of the Allies to insist not only that all objects removed shall be replaced, but also that equivalent value in kind shall be rendered for everything destroyed or damaged, and this should apply to specimens illustrating the study of natural history (best represented in value by original author's types), as well as to pictures, statues, and other objects of art or antiquity, for the selection of which from German museums special commissioners should be appointed.

WALSINGHAM.

6 Montagu Place, Portman Square, W.1,
August 29.

The Value of Insectivorous Birds.

THE reflections in a letter to NATURE (August 15) on shortcomings in the administration of the Wild Birds' Protection Acts, in so far as they relate to the eggs of the lapwing, which, it is stated, appear on the prohibited lists of only eight Scottish authorities, are now happily at variance with the facts. Far from such being the state of the case, at the present time and for more than ten years past no fewer than twenty-eight—out of thirty-four—Scottish county councils have protected the eggs of this bird, after certain dates which permit of only the first layings being taken for food purposes.

As regards the skylark, the taking of eggs is altogether prohibited, not by twenty-three authorities in

England and Scotland, as stated, but by twenty-eight county councils in Scotland alone, and this also has been the case for more than ten years.

WM. EAGLE CLARKE.

The Royal Scottish Museum, Edinburgh.
August 26.

A Mistaken Butterfly.

THE following observation will be of interest in connection with those related in NATURE, vol. xcv., 1915.

At Pennant Hills, near Sydney, on March 24 last, I noticed an interesting case of colour-attraction for a butterfly. A lady was standing talking to two other persons on the footpath opposite my house. She was wearing a plain brown straw hat, fixed with a hat-pin having a light blue porcelain knob about half an inch in diameter. A butterfly (*Papilio sarpedon*) kept flying about the knob as if fascinated, and followed the lady closely when she went up the footpath to the house, flying away only when the lady entered the house.

I watched it for quite five minutes, during which time the butterfly never went more than a few inches from the lady's head, and always returned to the blue knob, apparently trying to alight thereon. The lady several times brushed at the insect with her hand to drive it away.

THOS. STEEL.

Sydney, New South Wales.

FERTILISERS AFTER THE WAR.

IN view of the great increase in the facilities for making sulphuric acid, attempts have naturally been made to find an outlet for the new production after the war, and a Departmental Committee appointed to go into the subject has recently examined the possibility of an additional production of fertilisers, which before the war absorbed some 60 per cent. of the acid made. The report of the Committee (Cd. 8994, 1918) has already been discussed in these columns from the point of view of sulphuric acid production: it remains now to consider the effect on fertilisers. The report is very short and does not include the statistical data necessary for a full discussion of the problem: fortunately these can be collected from other sources.

Prior to the war the total consumption of artificial fertilisers in this country was something above 1,000,000 tons per annum, made up approximately as follows:—

	Estimated pre-war consumption in United Kingdom. Tons per annum	Estimated annual value. Pre-war prices £
Farmyard manure	37,000,000	11,000,000
Nitrate of soda	80,000	920,000
Sulphate of ammonia	60,000	750,000
Cyanamide (nitrolim) and nitrate of lime	10,000	110,000
Superphosphate	600,000	1,650,000
Basic slag	280,000	560,000
Guano	Say[1] 25,000	250,000
Bones	,, 40,000	200,000
Others	,, 10,000	100,000
Total	1,105,000	4,540,000

[1] No good estimate can be made of the amount of guano, bones, and other materials used as fertilisers.

At the same time the areas under the various crops in the United Kingdom were as follows:—

	Million acres in the United Kingdom
Wheat, barley, oats	7·67
Potatoes	1·21
Swedes, turnips, mangolds	2·28
Other arable crops	1·55
Temporary grass	6·61
Permanent grass	27·35
Total	46·67

This distribution of land and consumption of fertilisers gave the following amounts of food:—

	Quantity obtained: millions of tons			How utilised: millions of tons	
	Home-grown	Imported	Total	Eaten by human beings	Eaten by animals
Cereals	6·5	10·4	16·9	5·2	9·2
Potatoes	4·8	0·7	5·5	5·5	—
Other roots (estimated)	44·5	—	44·5	—	44·5
Grass (estimated as hay)	60	—	60	—	60
Other foods:—					
Sugar, fish, etc.	—	—	3·4	3·4	—
Cake, straw, etc.	—	—	6·3	—	6·3
Animal food:—					
Dairy produce (mainly milk)	4·7	0·5	5·2	5·2	—
Meat	1·8	1·2	3·0	3·0	—
Total	122·3	12·8	144·8	22·3	120

The experience of the war has shown that this type of production is not really the most satisfactory to the nation as a whole, as it leaves us far too dependent on foreign countries for supplies of wheat. On the other hand, a system of husbandry that produces much wheat is unsatisfactory to the farmer because of the possibility that heavy crops in the Argentine or North America or elsewhere might pull down prices to unremunerative levels. The risk may, in fact, never materialise, but it has been burned into the farmers' minds by the low prices of the nineties of the last century. In consequence, before the war wheat-growing was diminishing in this country, and grass was increasing.

Under the double stimulus of high prices and Government action farmers have during the war broken up more than 3,000,000 acres of grass land and thus added considerably to the area under cereals, particularly wheat and oats. The breaking up of the grass land has led to the production of much more food in the country and necessitated the use of more fertilisers. It is officially stated that we now produce breadstuffs sufficient for forty weeks per annum, whereas before the war we produced only enough for ten weeks. This does not, of course, mean that we produce four times as much food as formerly; the breadstuffs are not quite the same as they were; but it does show that we go a long way towards feeding ourselves.

The scientific problems involved are more straightforward and less controversial than the political and economic problems. If food production is wanted it can be done so far as scientific problems are concerned. The political and economic problems lie outside our present scope; they have been fully discussed in Lord Selborne's report on rural reconstruction. During the war these problems have, in fact, been largely solved, and in the view of Lord Selborne's Committee the increased production could be permanently maintained.

Assuming this were done, then, it would be necessary to put on a permanent basis the present rearrangement of areas under crops. Various schemes have been submitted. Broadly speaking, they involve the maintenance in arable cultivation of the three and a half or four million acres now taken off permanent grass and adding it to corn, thus extending the rotation from four courses to five, or from five to six. The interposition of a corn crop in this manner is quite possible in practice on two conditions—the land must be kept clean and fertilisers must be used. A reasonable dressing to use for cereals in these circumstances would be 1 cwt. of sulphate of ammonia or nitrate of soda and 2 cwt. of superphosphate per acre. This would not give a measure of the total consumption of fertiliser necessary, because the taking out of 4,000,000 acres of permanent grass would necessitate the improvement of the remainder in order that the same quantity of grass might be grown; an average dressing per acre of 1 cwt. of basic slag would be a reasonable application here. Two estimates are given in the report:—

Estimated Post-war Consumption.

	Pre-war consumption : tons per annum	Sir T. H. Middleton's estimate : tons per annum	Sir Charles Fielding's estimate : tons per annum.
Sulphate of ammonia...	60,000	—	360,000
Superphosphate	743,000	1,367,000	1,643,000
Basic slag	263,000	892,000	1,463,000

It is improbable that the production of basic slag would ever attain the high figures quoted here, while, on the other hand, much greater quantities of superphosphate can be made even than the 1·6 millions required on Sir Charles Fielding's estimate. Some of the slag would therefore in practice be replaced by superphosphate.

Of the two sets of figures Sir T. H. Middleton's is the more likely to be realised. Estimates for sulphate of ammonia are difficult to make because to a large extent, and yet not altogether, sulphate of ammonia is replaceable by, and can itself replace, nitrolim or calcium cyanamide and nitrate of soda. It would not be difficult to make a reasonable guess at the total amount of combined nitrogen the farmers of the United Kingdom might be expected to use, but it is impossible to forecast the way in which they will take it. Thus we might assume the following distribution of crops and consumption of fertilisers:—

	Area		Fertilisers used : tons	
	Total, million acres	Manured, million acres	Superphosphate and basic slag	Nitrogen expressed as sulphate of ammonia
Wheat, barley, oats	11·2	3·0	300,000	150,000
Potatoes	1·5	1·5	150,000	75,000
Swedes, turnips, mangolds	2·6	2·6	390,000	130,000
Other arable crops	1·6	0·9	90,000	45,000
Temporary grass	6·0	2·0	200,000	50,000
Permanent grass	23·8	12·0	600,000	20,000
Total	46·7	22·0	1,730,000	470,000

Here all the combined nitrogen is expressed for convenience in the form of sulphate of ammonia, but it must be understood that other compounds can be used also. This leads to the conclusion that 470,000 tons of sulphate of ammonia (or the equivalent of nitrolim and nitrate of soda) and 1,730,000 tons of phosphates (superphosphate and basic slag) could be utilised annually in the United Kingdom—figures, however, which are below those of Sir Thomas Middleton in so far as phosphates are concerned.

However, all these estimates are necessarily hypothetical; no one knows what will happen after the war. Unless the great political and economic problems involved are satisfactorily dealt with we may yet see the land going back to grass in spite of all our endeavours.

E. J. RUSSELL.

THE VALUE OF THE HERRING AS FOOD.

THE report for 1917 of the Lancashire Sea-fisheries Laboratory is chiefly devoted to a paper by Dr. J. Johnstone on the dietetic value of the herring. It is not necessary to emphasise the present importance of this subject, for the fact is now well known that in the days before the war a small proportion only of the herrings landed in this country was consumed by our own population, a proportion which Dr. Johnstone estimates at as low as 20 per cent. The Government Departments responsible for fishery questions are fully alive to the possibilities which will occur after the war for utilising the fish which were previously exported, and so adding substantially to the national food supply. Already steps are being taken with the view of placing these fish on the market in a more attractive and palatable form than the salted or pickled herrings which constituted the bulk of the exported article, and if the public once realises the food value of the fish the whole supply might well be retained at home.

Dr. Johnstone's analyses of the flesh of the herring have been made chiefly on fish from the Irish Sea, and as the most novel feature of his results is the clear and definite way in which he shows that the composition of the flesh varies very greatly in samples of fish taken at different seasons and in different states of development, it becomes important that analyses of a similar kind should be carried out in other fishery regions, especially in connection with the great herring fisheries of the North Sea. As an example of the extent of this variation the following figures from Dr. Johnstone's paper may be quoted (p. 31):—

Manx Summer Herrings: Fisheries of 1916 and 1917.—Composition of the Flesh of the Fish: Monthly Means.

Date	May, 1916	May, 1917	Aug., 1916	Aug., 1917
Condition	Virgin	Virgin	½-Full	Full
Water	75·0	68·5	48·4	43·5
Oil	2·5	5·4	31·5	36·6
Proteid	21·1	19·7	16·5	15·7
Ash	2·3	3·3	2·3	2·9
Total	100·9	96·9	98·7	98·7
Energy values (calories)	1100	1330	3608	3943

The most striking variation is in the fat, which rises from about 2½ per cent. at the beginning of the season to more than 36 per cent. in August, when the fish are not far from the spawning phase. After spawning has taken place a great reduction in the percentage of fat occurs, spent fish obtained in September, 1914, showing a reduction to about 9 per cent.

In addition to many analyses of fresh herrings the paper contains similar figures for cured fish of various kinds, pickled herrings, kippers, bloaters, and red herrings. A few samples of sprats were also analysed.

It must be clearly stated that the figures given apply only to the "flesh" of the herrings, including the skin (*minus* scales). The author makes the curious statement that "from the point of view of dietetics it is only the flesh that matters," But surely the roes and milts of "full" herrings are about the best and most nutritious parts of the fish, and the value of the fish as food will not have been adequately dealt with until we have figures in which these are included in their due proportions.

Amongst other aspects of the question discussed by Dr. Johnstone are the effects of cooking and the chemical effects of salting herrings, as well as a number of physiological matters, such as the locus of the fat, the nature of the fat, and the seasonal metabolic phases. The paper is one of great interest, and it is to be hoped that the subject will be followed up.

E. J. A.

THE METALLIFEROUS ORES OF THE IRON AND STEEL INDUSTRY.[1]

IN June, 1917, the Department of Scientific and Industrial Research published a report dealing with the metalliferous raw materials of the iron and steel industry of the United Kingdom, the Allies, and the neutrals. Its object was to collect and summarise in a form which can easily be consulted as much information as possible from the principal literature pertaining to the sources of iron ores, and other metalliferous ores accessory to the metallurgy of iron and steel; to describe their composition and character, giving analyses where possible, together with indications as to the geographical position and the accessibility of the minerals. The report did not claim to give the results of independent researches, but merely to provide for the inquirer information for which he would otherwise have to search through a great variety of publications and monographs issued by technical and scientific societies and geological surveys. How useful this publication has been to the iron and steel industry is shown by the fact that the stock of copies was almost exhausted three months after publication.

It soon became apparent that the value and the scientific completeness of the report would be greatly enhanced if an account were given of the supplies of the ores in enemy countries also, and the issue of a new edition has provided the opportunity of adding this information. Some later statistics are also given, and various errors and omissions have been corrected. The second edition accordingly consists of three parts: (1) Notes on the iron ores of the United Kingdom and British dominions; (2) notes on iron-ore deposits in foreign countries; (3) notes on the ores of the principal metals, other than iron, used in the iron and steel industries. The last-named part describes the occurrence and composition of the ores of chromium, cobalt, manganese, molybdenum, nickel, titanium, tungsten, vanadium, and zirconium, and the principal uses of the special steels or ferro-alloys made from them.

The German steel industry is based upon, and was rendered possible only by, a discovery of two Englishmen, Sidney Gilchrist Thomas and Percy Carlyle Gilchrist. This discovery, which in their hands became also an invention, brought within the scope of economic development the vast supplies of phosphoric ores (Minette) of Lorraine and Luxemburg, and of the Salzgitter and Ilsede districts, which were thus made available for the manufacture of commercial steel on a great scale. As the industry grew its requirements were supplemented by imports from the Briey orefield in France, which is the main part of the same ore body which extends to annexed Lorraine and Luxemburg. These ores were all treated by the "basic" process. For the raw materials of acid steel and steel of special quality, Germany had to depend on imports derived mainly from Sweden, Spain, and Russia.

In May, 1915, a secret memorial, drawn up by six great industrial and agricultural associations in Germany, was presented to the Chancellor. A translation of this was published by the Comité des Forges de France in August, 1915, and from it the following quotation is taken: "Concerning France . . . besides the iron-ore region of Briey, it would also be necessary to acquire the coal region in the Departments of Nord and the Pas de Calais; the security of the German Empire imperatively requires the possession of all the Minette mines, including the fortresses of

[1] "Report on the Sources and Production of Iron and other Metalliferous Ores used in the Iron and Steel Industry." (H.M. Stationery Office.) Price 2s. net.

Longwy and Verdun, which are necessary for their defence; the possession of the vast quantities of coal, and specially of the bituminous coal, which abounds in the North of France is no less important than the acquisition of the iron-ore mines."

Not long after the outbreak of war the German steel industry was beset by serious difficulties owing to the fact that the imports of manganese ore, one of the essential accessories, were cut off, and it was predicted by more than one authority in this country that the shortage of this ore would cause a crisis in, and the eventual stoppage of, the German steel industry. Confident predictions were made as to the date beyond which, for this reason, the war could not be continued by Germany. These predictions entirely failed to take into account the very considerable deposits of manganiferous iron ore contained in the German Empire. In 1911 $2\frac{3}{4}$ million tons of such ore containing less than 12 per cent. of manganese, and 288,000 tons containing between 12 and 30 per cent., were mined. These constituted, therefore, important sources of production when the pinch came. There is good reason for thinking that about ten months' stocks of high-grade ore were present in the country at the outbreak of war, and these were greatly augmented by the confiscation of supplies found in Belgium and North-east France. The mines producing high-grade ore were stimulated to the utmost activity; means are said to have been devised for recovering the slag produced at the ferro-manganese blast furnaces, and also from basic-steel slag. By the desulphurisation of blast-furnace coke certain economies in manganese are considered to have been effected. There is to-day no evidence that Germany is in serious difficulties with regard to steel production owing to the cutting off of external sources of manganese ore.

In pre-war times Russia produced more manganese ore than any other country. In 1913 the output was 1,175,000 tons; most of this was exported and went through the Dardanelles. How heavily this industry was hit by the war is shown by the fact that in 1915 the production is stated to have been only 9750 tons. India, much the largest source of supply within the Empire, was a close competitor of Russia, and, apart from a drop of output in 1915, production has been well maintained. Much of the Russian export went to the United States of America, and the iron and steel industry in that country has been placed in considerable difficulties in consequence. For a time the deficiency was made good by imports of the high-grade ores mined in Brazil. With the acute shortage of ship tonnage which now exists, however, a most urgent appeal has been made to the iron and steel manufacturers in the United States to utilise home sources of ferruginous manganese and manganiferous iron ores.

The Department of Scientific and Industrial Research is to be warmly congratulated on the publication of a report which gives in a well-arranged and lucid form just the information it set out to collect and systematise. It is to be hoped that it will become one of its standing publications, and that from time to time new editions with the most up-to-date information will be issued.

H. C. H. CARPENTER.

PROF. BERTRAM HOPKINSON, F.R.S.

THE death, in a flying accident on August 26, of Col. Bertram Hopkinson, C.M.G., F.R.S., professor of mechanism and applied mechanics in the University of Cambridge, is a grievous loss to science and the nation. Born in 1874, the eldest son of Dr. John Hopkinson, F.R.S., he inherited not a little of his father's scientific insight and genius for bringing science to bear on practical matters. This hereditary aptitude was fostered by close contact with his father's mind in early life; he was his father's frequent companion in work as well as in play. Bertram lived at home, attending St. Paul's School until he went to Trinity, where he took the Mathematical Tripos. An unlucky illness compelled him to take an ægrotat degree in the First Part; but he showed his quality in the Second Part, when he was placed in the First Division of the First Class. He then read for the Bar, devilling in a well-known counsel's chambers, and had been "called" when the tragic death of his father, along with a younger brother and two sisters, while climbing near Arolla in 1898, changed the current of his life. He boldly took up his father's business as a consulting electrical engineer, in association with his uncle, Mr. Charles Hopkinson, and Mr. Talbot, a former assistant. With them he carried out various tramway undertakings during the next four or five years.

In 1903 Hopkinson was elected professor of mechanism and applied mechanics at Cambridge, in succession to the present writer. To many the appointment of so young and comparatively unknown a man must have seemed surprising, but those who knew Hopkinson were confident that the electors had made a wise choice. It was entirely justified by the result. In Hopkinson's hands the Cambridge School of Engineering prospered exceedingly, going from strength to strength in numbers, in academic and professional repute, and, above all, in activity as a centre of research. Hopkinson was himself devoted to research, and could inspire his pupils with a like ardour. In some instances a pupil's name appears as joint author of the published paper; in others the pupil was himself left to complete and publish the work.

No one, I think, can read Hopkinson's papers without being reminded of those of his father. There is something of the same freshness of outlook, the same penetration and grasp, the same personal detachment, the same directness in attack, the same unconventionality in method, the same avoidance of side issues and concentration on the essence of the problem. It is impossible to do more here than give the briefest indication of their general scope. One group deals with elastic hysteresis in steel and the endurance of that metal under repeated cyclic variations of stress. For these experiments he designed an ingenious "fatigue-tester" to apply alternations of pull and push at a rate as high as 7000 per minute by using electro-magnetic action to maintain the vertical oscillation of a heavy armature attached to one end of the test-piece. Another important group of papers deals with gaseous explosions. His researches in this subject have done much to clear away earlier misconceptions and to bring out features in the process of explosion that had been overlooked. They disposed of wrong ideas about "after-burning," but at the same time showed how far from uniform is the condition within a closed combustion-vessel at the moment when the maximum pressure is attained.

As joint secretary with Sir Dugald Clerk of the British Association Committee on Gaseous Explosions, as well as by his own experiments, Hopkinson did much to advance our knowledge of an intricate problem. He applied similar methods of inquiry to the analysis of what occurs in an internal-combustion engine; in this connection his optical indicator is of great service. During the years immediately before the war he was engaged in studying the pressure produced by the detonation of high explosives and by the impact of bullets. For this he devised methods of measurement which were admirably simple and effective. They were described in a Royal Institution lecture in 1912, and more fully in the Philosophical Transactions of the Royal Society for 1914. Hopkinson also edited a reprint of his father's scientific and technical papers, and wrote for it a short memoir, which was published in 1901.

On the outbreak of war he threw himself with characteristic vigour into national service, to the exclusion of all other interests. At Cambridge he had been a keen promoter of the Officers Training Corps. He first undertook R.E. duty at Chatham in order to relieve others for active service. Later he was engaged for a time at the Admiralty on work of a kind quite new to him, which he attacked with conspicuously good effect. He had the satisfaction of seeing an invention, which he made to meet one of the bigger difficulties of the war, promptly tested, adopted, and officially recognised. Concurrently with this he acted as secretary of a committee set up by the Royal Society to assist the Government, a position which brought him into touch with many other war questions and with the men busied in them. His attention began to be directed to the equipment of aircraft, and soon he became absorbed in this task, accepting a position in what is now the Royal Air Force. There, perhaps as never before, he found his opportunity. His powers were acknowledged and turned to full account; he received promotion, and the range of his authority was enlarged. He revelled in his work, put everything aside for it, was unsparing of himself. He knew well that flying, especially for a man no longer young, meant a serious risk; but he felt that the risk had to be taken if the work were to be well done. So he flew, from one air station in England to another, or even to France, generally as his own pilot.

All who knew Hopkinson esteemed him for a man of strong character and sane judgment, of unswerving straightness in thought and action, with a rare freedom from egotism or self-seeking or any pettiness. But it was only in the intimacy of the domestic circle that one learnt what a wealth of affection lay behind his reserve. In 1903 he married the eldest daughter of Mr. Alexander Siemens; she survives him with seven daughters. His family life was an ideally happy one save for the calamity of 1898 and for the death of his brother Cecil, a young man of like tastes and of the finest promise, who died last year of a wound received in Flanders. In claiming them both, the War has taken of our very best.

J. A. EWING.

NOTES.

THE Società Italiana delle Scienze (detta dei XL) has awarded the natural sciences gold medal for 1918 to Prof. Filippo Eredia for his work in meteorology. This is the first time that, in Italy, studies in the field of meteorology have been rewarded in this way.

A TELEGRAM received at the Meteorological Office on August 26 from the Director-General of Observatories in India states, with reference to the Arabian Sea and Bay of Bengal, that the monsoon is normal, and that no cyclonic storm has occurred.

WE regret to note that *Engineering* for August 30 records the death of Engineer Rear-Admiral Francis Henry Lister. Admiral Lister was well known in the Service, and was closely identified with the construction of machinery in the contractors' works, not only for the Navy, but also for several ships ranked as auxiliaries to the Navy, including the *Mauretania* and *Lusitania*. His age was fifty-six years, and he had given thirty-nine years to the service of his country in the Navy. He was a member of the Institution of Naval Architects and of the Institution of Mechanical Engineers.

THE principle that every large industrial firm should have its own research laboratory appears to have been accepted more generally in America than it has been in this country, and as a consequence a large proportion of our knowledge of the working of such laboratories comes from American sources. In the August issue of the *Scientific Monthly* there is, for example, a valuable paper on research and industry by Dr. P. G. Nutting, the director of the Westinghouse Research Laboratory at East Pittsburgh. Dr. Nutting points out that in addition to technical research, such as the testing of the materials received and produced, the elimination of works troubles, and the starting of new processes, it is necessary to carry out scientific industrial research on basic principles, and on their relations to the more obscure and fundamental works troubles. He considers that the best preparation for industrial research as a profession is a thorough grounding in principles, followed by research sufficient to justify the award of a doctor's degree in the best American universities.

A ROYAL Commission has been appointed "to consider and report whether it is advisable to make any changes in the denominations of the currency and money account of the United Kingdom with the view of placing them on a decimal basis, and whether, if an alteration of the present system is recommended, it is desirable to adopt with or without modification the proposals embodied in the Bill recently introduced into the House of Lords by Lord Southwark or some other scheme, and in the latter alternative to make specific recommendations for consideration by Parliament." The members of the Commission are:—Lord Emmott, Lord Southwark, Lord Faber, Lord Ashton of Hyde, Lord Leverhulme, Sir R. V. Vassar-Smith, Bart., Sir J. Larmor, Sir G. Croydon Marks, Sir A. W. Watson, Mr. J. W. Cawston, Mr. S. Armitage Smith, Mr. C. Godfrey, Mr. J. Bell, Mr. J. Burn, Mr. H. Cox, Mr. G. Hayhurst, Mr. T. McKenna, Mr. G. Marks, Mr. J. F. Mason, Mr. A. Smith, Mr. G. M. Smith, and Mr. G. C. Vyle.

ALTHOUGH a reinforced-concrete barge of 400 tons has been in use on the cross-Channel service for some months, the vessel launched on August 24 at Lake Shipyard, near Poole, is the first 1000-ton reinforced-concrete sea-going barge completed in the United Kingdom, and forms one of a fleet of similar vessels at present in course of construction at Admiralty extension shipyards in different parts of England, Scotland, and Ireland. From an illustrated article in *Engineering* for August 30 we learn that there are now eight 1000-ton barges on the slips at the Lake yard, which was laid out to suit this class of work by Mr. Anthony G. Lyster, of Sir John Wolfe Barry and Partners. When finally completed, the slipways will provide accommodation for the simultaneous building of sixteen vessels ranging up to 2500 tons dead-weight carrying capacity. The vessels under construction were designed by Mr. E. O. Williams, the hull in every case having a double bottom and double sides. It is interesting to know that the experience gained in the building of this pioneer vessel has already resulted in the introduction of various improved methods of procedure. The vessel was constructed to the classification of the British Corporation for the Survey and Registration of Shipping.

THE death is announced of Prof. Henry Shaler Williams, of Cornell University, U.S.A. Prof. Williams was born at Ithaca, N.Y., on March 6, 1847, and graduated at Yale in 1868. His early inclinations were towards biology, and his first paper, in 1872, made a comparison between the muscles of the chelonian and human shoulder-girdles. Soon, however, he turned to the study of fossils, with special reference to their use in stratigraphical geology, and in 1879 he was appointed professor of palæontology in Cornell University. In 1886 he became professor of both geology and palæontology in the same university, and in 1892 he succeeded James D. Dana as Silliman professor at Yale. In 1902 he returned to Cornell, and in 1912 he retired from active service, with a pension under the Carnegie Foundation. Prof. Williams devoted his attention chiefly to the invertebrate fossils found in the Devonian formations of the eastern part of North America, and published an important series of memoirs on the correlation of these rocks and faunas in the Bulletin of the United States Geological Survey. At the same time he detailed the results of his researches, especially on brachiopods, in other papers, and in 1895 he produced a most useful and original handbook entitled "Geological Biology, an Introduction to the Geological History of Organisms." He was among the pioneers in the modern methods of studying fossils, and most industriously tested their value in the sphere which he made his own.

THE death of Dr. Robert Saundby on August 28, at the age of sixty-eight, leaves a gap in the ranks of contemporary leaders of British medicine. From his first appointment as pathologist at the Birmingham General Hospital in 1876 until his retirement from the University chair of physic in 1917, when he became emeritus professor, Dr. Saundby devoted himself to medical problems in their scientific aspects, especially in regard to abnormal states of the urine in renal disease and diabetes, and to disorders of the stomach and digestive system. His works on "Renal and Urinary Diseases" (fourth edition, 1900) and on "Diseases of the Digestive System" (second edition, 1907) embody the scientific knowledge and clinical experience of a physician who pursued in the laboratory the studies begun in the wards of a large hospital, and was well acquainted with the writings of other workers in the same domain. Besides these monographs, Dr. Saundby made considerable contributions to medical literature in the form of articles and scholarly addresses. The scientific attitude of his mind was strongly reflected in his clinical work and in his lifelong interest in research. To the last he was receptive of new ideas, and his readiness to test such new methods or findings within his province as attracted his critical faculty kept him continuously abreast of his times. But Dr. Saundby was more than a clinician, and his books on "Medical Ethics" (second edition, 1907) and on "Old Age: Its Care and Treatment" (1913), as well as the distinguished positions to which he was elected by his fellows, bear witness to his strong personality, sound judgment, and versatility. Throughout his career as a consulting physician in busy practice Dr. Saundby's energy and public spirit were further displayed in other fields of professional interest. He was a strenuous supporter of the British Medical Association, holding the office of chairman of the council and becoming president of the association in 1911. He was also a member of the General Medical Council, and at the Royal College of Physicians he was Harveian orator in 1917, lecturing on the congenial theme of "Harvey's Work Considered in Relation to Scientific Knowledge and University Education in his Time."

CONSIDERABLE interest was taken last week in the demonstrations of "reading by ear" at the British Scientific Products Exhibition. The original construction of Dr. Fournier d'Albe's "type-reading optophone" was described in NATURE for September 3, 1914. This construction has recently been modified by replacing the Nernst lamp by a small drawn-wire lamp, and by arranging the whole apparatus in such a manner that any ordinary book or newspaper can be inserted and read without cutting it up into pages or columns. The demonstrations consisted in taking an ordinary book of clear type, opening it at random or at a page chosen by the audience, and asking the blind pupil to read a few words or lines on that page. By a curious coincidence the first words thus read were "in the light." The reader, a girl of nineteen blind from early infancy, was the first blind person to read by ear. She read an unknown page of print without assistance after twenty lessons of one hour each, spent in learning the alphabet and in deciphering words of gradually increasing length. The only letters which offered any real difficulty were *c*, *o*, *p*, and *q*. The Roman alphabet is less suitable for optophone reading than either the Gothic or the Russian alphabet, and it might easily be re-designed so as to increase its legibility. But even as types are now, they are sufficiently legible to make all the literature printed clearly in them freely accessible to the blind through Dr. Fournier d'Albe's very ingenious instrument and by the exercise of reasonable practice in distinguishing the sounds associated with letters and words.

ON the linguistic side the Bureau of American Ethnology, according to its thirty-first report, for 1909–10, published in 1916, was specially engaged, under the superintendence of Dr. Franz Boas, in bringing nearly to completion the first volume of the "Handbook of American-Indian Languages." The most important work on the first volume was a thorough revision of the Algonquin sketch by Dr. W. Jones, which she has nearly completed. Miss Densmore is analysing about 500 songs collected from a representative number of localities, which will form a scientific musical study of primitive song. The remainder of the volume of the report is devoted to an exhaustive account of Tsiinshian mythology, based on a series of texts recorded by Mr. H. W. Tate.

MR. F. B. C. BRADLEE contributes to the Historical Collections of the Essex Institute (vol. liv., No. 2, April, 1918) a paper on the Salem Iron Factory, which possesses more than local interest. The first ironworks of any importance were started at Lynn, Massachusetts, in 1643, and the first iron pot made in New England was cast in that foundry in the same year. The Danvers ironworks and rolling mills were founded by Nathan Read, of Salem, whose ancestors came from Newcastle-upon-Tyne. He was born in 1759, and two works were started in 1796. He was the inventor of one of the first machines, and perhaps the earliest, for cutting and heading nails in one operation. Mr. Bradlee in his paper publishes a number of early documents which are of value as a record of this industry in the United States.

DESPITE the prevalence of war conditions, the Geological Survey of New Zealand continues its handsome series of bulletins with Prof. Jas. Park's memoir on "The Geology of the Oamaru District, North Otago" (1918). This is the typical area for the Oamaruian series, and the Ototara stage is now rescued from what the author calls the "hyphenated" Cretaceo-Tertiary group of former classifications. Everything in the district above the Palæozoic schists is now classed as Miocene or Pleistocene. At the base of the Ototaran strata near Peebles pillow-lavas occur, which were evidently poured out as submarine flows during the deposition of the fossiliferous limestone. The ample lists of molluscs and brachiopods, by Mr. Suter and Dr. J. A. Thomson respectively, establish the Miocene, and probably Middle Miocene, age of the Oamaruian series.

THE controversy regarding the relation of magic to religion is again raised in a vigorous manner by Mr. N. W. Thomas in a paper entitled "Magic and Religion: a Criticism of Dr. Jevons" (*Folk-lore*, xxviii., 259), in the same journal, vol. xxix., part 2. Dr. Jevons asserted that we should reserve the term "magic" "exclusively for the proceedings which excite the disapproval of the community," which, as his critic points out, includes under the head of "magic" not only all crime, but also offences against etiquette. "To frame an adequate definition of magic, it is necessary to survey the whole field of primitive rites and to group the facts according to their natural affinities without regard to the terminology of the reporter. In only too many cases the native view cannot be discovered; failing some knowledge of the language, the observer falls back on his own preconceptions, and while we get a good account of the details of a rite, we get none of the atmosphere with which the native mind surrounds it."

THE peoples of Austria are statistically considered by Mr. B. C. Wallis in a paper in the July issue of the *Geographical Review* (vol. vi., No. 1), which is accompanied by several excellent maps in colour. Three of these maps show respectively the relief of the land, the density of population, and the distribution of nationalities. The last map illustrates the patchwork of races of which Austria consists, and shows clearly that in most of Austria the inhabitants are not of Teutonic race, and that there is no race characteristic to Austria like the Magyars to Hungary. Czechs, Poles, Ruthenians, and Rumanians form 50 to 95 per cent. of the population in different parts of northern Austria. From Carinthia and the Tyrol southwards Italians and Slavs are the predominating races. This leaves a comparatively restricted area, comprising principally the mountains of the centre and the Danube valley, in which Germans predominate. Mr. Wallis believes that if the principle of nationality is given due consideration in the final settlement, the outlooks of Germany eastward and towards the Mediterranean will be barred, and that the Germans of Austria will be separated from the Prussians by the Czechs. The best lands of Austria will no longer be in German hands. The paper raises many interesting issues, and contains many facts essential to any understanding of the settlement of the Austrian question.

AN account of the amphibians collected by the American Museum Expedition to Nicaragua in 1916 appears in the Bulletin of the American Museum of Natural History, vol. xxxviii., pp. 311–47. Though, of necessity, very technical in character, it yet contains some noteworthy observations in regard to the life-histories of these animals, especially in relation to coloration and structural variations. A good instance of the latter is furnished by a tiny tree-frog, no more than 16 millimetres in length. New to science, and designated *Hyla chica*, this little creature displays a striking range of variation in regard to the digital expansion used in climbing, and a no less marked reduction of the webs of the toes. *Agalychnis helenae*, another small tree-frog, showed chameleonic changes of colour which were not, apparently, due to changes in the intensity of the light. Finally, stress is laid upon the profound alterations of colour which take place in specimens preserved in spirit.

THE annual report for 1917 of the New Jersey Department of Conservation and Development insists on the abolition of all legislation framed for the protection of deer and rabbits within the boundaries of the State; and this because of the depredations of the deer, which, driven out of the forest by fires caused by deer-hunters, raid the crops of the farmers. It is contended that material interests of great value are being sacrificed to sport. But, judging from the report, hunters in this State are accorded a surprising licence. Strenuous efforts are urged to drain some 300,000 acres of marshland, now infested with mosquitoes, in order that they may become available for cultivation; and for this work it is suggested prison-labour should be employed. The forest fire service report, included in this volume, proves interesting reading, if only for the insight it affords into the management of large forests in view of our own afforestation schemes.

THE collection of sea-anemones made by the *Terra Nova* Expedition is described by Mr. T. A. Stephenson (British Antarctic *Terra Nova* Exp., 1910, Zool., vol. v., No. 1, pp. 1–68, 6 pls., 1918). Fifteen genera, all belonging to the Actiniina, are represented, each by a single species. The author describes as new five genera and eleven species. Seven species were obtained in the vicinity of McMurdo Sound, and two of these were also taken in Ross Sea. All these were dredged from deep water, and most of them have a thick, stiff body-wall. The remaining eight species were collected in New Zealand, off Rio de Janeiro, off the Falkland Islands, and at South Trinidad Island. A careful description is given of each species, and, thanks to the excellent preservation of the material, an account of the histology of most of them is added. In the examples of Leptoteichus, Bolocera, and Cymbactis the author found numerous zooxanthellæ in or around the gonads, and in Phymactis the greater part of the mesoglœa of the mesenterial filaments is crowded with small zooxanthellæ.

WE have recently received three additional parts of vol. v. of the Scientific Reports of the Australasian Antarctic Expedition, 1911–14. In part ii. (5 pp.) Miss Mary J. Rathbun gives an account of the crabs which are referable to three species, two of which are well-known species of Halicarcinus and Nectocarcinus. The third is a megalops stage of large size, taken off Macquarie Island, and described as *Marestia mawsoni*, n.sp. In part iii. (48 pp., 15 pls.) Prof. G. S. Brady reports on the Copepoda from the tow-nettings; fifty-three species are noted, twenty-five of which are described as new. The species fall into thirty-eight genera, six of which are new. Several of the more prevalent Antarctic forms in the collection were previously known only from Giesbrecht's descriptions in his report on the collection made by the *Belgica*. These seem to be purely Antarctic species, while a few others, *e.g. Calanus propinquus*, seem to be almost cosmopolitan in distribution. In part iv. (11 pp., 2 pls.) Prof. Brady gives an account of the Cladocera and of the Ostracod family Halocypridæ.

THE diminution of foreign imports into India has forced the Forest Department to exploit local sources of supply. Home-grown timber is now largely used for industrial purposes. Indian walnut has lately replaced the European variety for rifle-stocks; Chir pine has been found equal to that of Oregon for gun-carriages, and Himalayan spruce is little inferior to the famous Sitka variety for the manufacture of aircraft. Materials for paper are being successfully utilised, and tar for the Calcutta jute industry is being distilled in the Punjab. A solution of gum from *Bauhinia retusa* has been successfully used as a binding material for making charcoal briquettes. On the whole, the efforts of the Forest Department to utilise indigenous resources have been well conceived, and promise to be financially successful.

THE Geological Survey of Great Britain, in the sixth volume of its special reports on the mineral resources of the country (1918, 7*s*. 6*d*.), describes the occurrences of refractory materials, including dolomite. Dr. J. W. Mellor has furnished tests of many of the samples. One of several interesting points is the present demand for calcined dolomite as a lining for converters or for the beds of open-hearth furnaces in steel manufacture. The rock should be a compact, nearly pure dolomite—that is, with some 21 per cent. of magnesia. Silica should not exceed 2 per cent. The manufacture of silica bricks from ganister and quartzite is also described. The crushed rock is usually bound by an addition of some 1·5 per cent. of lime during grinding, and the moulded bricks are fired at a temperature of about 1500° C.

WE have received from the Palæontological Laboratory of Yale University a collection of reprints detailing the results of the recent activities of Prof. Charles Schuchert and his associates. They are very varied, ranging from notes on the Palæozoic rocks in the Grand Cañon of the Colorado to the evolution of Palæozoic corals and the function of the so-called sacral brain in dinosaurs. One paper by Prof. R. S. Lull (from *Amer. Journ. Sci.*, May, 1918) is a welcome contribution to our knowledge of the footprints of Carboniferous land vertebrates. The animals which made these prints are still unknown, but they seem to have been very bulky, small creatures with sprawling legs, having broad, stumpy feet and four toes in front, five toes behind. The absence of any trace of the tail shows that the body was carried clear of the ground.

METEOROLOGICAL tables giving the mean values in 1917 for the several elements at Falmouth are published in the "Report of the Observatory Committee of the Royal Cornwall Polytechnic Society," and some notes of interest are added. The minimum barometer reading for the year, 970·0 mb. or 28·645 in., was recorded on August 27; it is the only instance that the minimum pressure has occurred at the observatory in the month of August. Air temperature had a mean of 49·4° for the year, which is the lowest since observations were commenced in 1882; the next lowest annual mean was 50·2° in 1888. From January 14 to February 3, a period of eighteen days, the maximum temperature only once reached 40°, apparently an unprecedented circumstance in the district. The total rainfall was 36·21 in., which is 9·58 in. below the average of the forty-five years, 1871–1915. The minimum fall in any month was 1·83 in., in December, which is the lowest record for that month, and is in marked contrast to 11·14 in. measured in December, 1915. Bright sunshine registered 1632 hours during the year, which is 132 hours fewer than the mean for the thirty-five years 1881 to 1915. In an easterly gale on January 27 the height to which the water washed the cliffs is stated to be unprecedented so far as is known. A table of sea temperature values is given, and as the means at the station are now available for about forty years, the results are of considerable value. Some improvement might probably be made by comparing the sea temperature mean for the several months with the corresponding days of air temperature, instead of with the means of air temperature for the several months, and the maximum and minimum comparisons seem also open to question. The new scale values are not systematically used, but this is probably a matter of time, as with many other observatories.

THE manufacture of synthetic indigo in Germany is still considerably hampered through shortage of raw materials (*Zeitschrift für angewandte Chemie*, June 21). The recent discovery of a practical source of acetic acid in calcium carbide has given new life to the industry by securing supplies of one of the most important raw materials. The relatively high prices for synthetic indigo have favoured the cultivation of the indigo plant in Eastern countries. Two large factories in the United States have commenced the manufacture of artificial indigo.

Dagens Nyheter, Stockholm, reports that it has been decided to install a high-power wireless station at Karlsborg. The range is 5000 km., and the masts will be 210 m. high, and weigh only 25 tons. The radiating system is formed of 60 phosphor-bronze wires 450 m. long. A balancing antenna is provided, consisting of a bronze wire 1 mm. thick, suspended 5 m. above the ground over the entire area of the station. The energy will be supplied from the generating station at Trolhättan, and an emergency generator is installed at the station.

A REMARK in NATURE of August 22, p. 493, referring to the use of Moissan's electric furnace for the production of pure substances, and stating that these "rendered possible the practical achievements of Sir Robert Hadfield and other great steel-makers," needs correction for the sake of historical accuracy. Sir Robert Hadfield's epoch-making experiments, which led to the production of his famous manganese steel, were made in 1882, and neither for this nor for the other valuable iron alloys invented by him was he indebted to Moissan's work. It was not until ten years later that Moissan turned his attention to high-temperature research, and by the preparation of chromium, tungsten, molybdenum, uranium, and many other metals in a fused form and high degree of purity enriched our knowledge of the chemical and physical properties of these elements.

IN accordance with its usual practice of late years, the Royal Meteorological Institute of the Netherlands has issued copies of the most disturbed magnetic curves obtained at De Bilt during 1916. The records cover seven sheets, and deal with twelve separate periods, each of thirty hours. There are traces in each case of D (declination), H (horizontal force), and V (vertical force). The D and H scale-values were practically constant throughout, the respective equivalents of 1 mm. of ordinate being 1·06′ and 3·4 γ, but the equivalent of 1 mm. in the V curves varies from 1·14 γ to 3·31 γ. Some of the disturbances were of considerable amplitude, but none at all outstanding. There are several good examples of "sudden commencements." The largest movement of this kind in H occurred on August 26, and was decidedly oscillatory. The usual tendency for the evening hours to be more disturbed than the forenoon is pronounced. Also, in nearly every case the value of V is enhanced in the late afternoon, up to at least 10 or 11 p.m., and depressed in the early morning hours. This is especially well illustrated in the two sets of curves numbered 2 and 3, which cover the sixty consecutive hours commencing at 7 a.m. on March 8. On most occasions short-period oscillations are prominent in the D and H curves during at least part of the storm. On some occasions, notably on November 12, these were of considerable amplitude, especially in H.

OUR ASTRONOMICAL COLUMN.

INFRA-RED STELLAR SPECTRA.—Some interesting experiments on the photography of stellar spectra in the extreme red have been made by Dr. P. W. Merrill, of the Bureau of Standards, Washington (Scientific Papers, No. 318). The actual tests were made at the Harvard College Observatory, where use was made of the 24-in. reflector, combined with objective prisms of different dispersions. The plates were sensitised for the red by staining with dicyanin, and pinaverdol was added when it was desired to photograph the yellow and green in addition. A large number of spectra of typical stars was obtained, with exposures ranging from 5 to 112 minutes, reaching in some cases as far as λ870, and showing the atmospheric absorption bands B, *a*, and A. Several examples are reproduced, and it is clear that results of considerable value to astronomers and physicists may be obtained in the future by this method. Among other results of interest Dr. Merrill has found a new absorption band in the spectra of the M stars at wave-length 760, which he has proved by laboratory experiments to belong to the titanium oxide series; in Mira there is possibly still another band between 810 and 820. In stars of class N new bands have been found at 692, 708, and 723, and these differ from the characteristic bands of carbon in degenerating towards the less refrangible part of the spectrum; it is suggested that they may possibly be due to cyanogen. The great contrast in energy distribution in the different classes of stars is very strongly emphasised by the extended range of observation. For classes B and A the blue portion is much the stronger; at class K the blue and red are about equal; while for classes M and N the red is the stronger.

MOUNT WILSON OBSERVATORY REPORT.—Although the director has been called upon to devote nearly all his time to the organisation and work of the National Research Council, the research activity at the Mount Wilson Observatory appears to have been so far well maintained. The report for 1917 refers to many subjects of the highest interest and importance, and it is only possible to mention a few developments to which attention has not previously been directed. The 75-ft. spectrograph has been adapted for visual observations in conjunction with the 150-ft. tower telescope, and the magnetic polarities of an average number of forty sun-spots were determined on each day of observation, besides measurements of the strength of field in a large percentage of these spots. Further tests of the presence of free electricity in sun-spots were also made, but, as in previous years, Stark effects were not observed, and the results were negative. The interesting results obtained by stereoscopic combinations of H_α images of the sun have been extended, and the method has been found extremely valuable in the study of prominences projected on the disc, and in showing their connection with the dark flocculi. Systematic work on the solar rotation is being continued with the greatest refinements, and it is hoped eventually to determine whether the suggested variations in the period are real, or depend upon instrumental conditions and personal equation. Stellar and nebular investigations continued to increase in several directions, and work on the parallaxes, proper motions, magnitudes, and distribution of the stars has been very fruitful. Of exceptional significance in the theory of stellar evolution is the definite conclusion that the intrinsically fainter stars move more rapidly than the brighter ones, irrespective of their distances from the sun. To facilitate the experimental work, which is so fundamental for the interpretation of celestial spectra, the physical laboratory in Pasadena has been enlarged to nearly double its former area, and additional equipment has been provided. Good progress was also made with the 100-in. reflector, the dome and mounting having been essentially completed, and the great mirror safely conveyed to the top of the mountain; it is expected that the telescope will be ready for test observations during the autumn.

THE DEVELOPMENT OF NEW INDUSTRIES.

A FACT brought to light at the British Scientific Products Exhibition, organised by the British Science Guild at King's College, is the dependence of industrial development upon the intelligent application of scientific knowledge and method. In most of the industries represented at the exhibition it is shown that the resources exist and that they merely await the application of the results of scientific research for their proper development, and the introduction of patient and persistent effort to turn these industries into successful commercial undertakings. The case of timber furnishes an example of our pre-war dependence upon supplies from abroad, when, in point of fact, the bulk of our demands could have been satisfied by home or Colonial supplies. For a long time it was impossible to make the successive Governments of this country realise that the afforestation of waste lands was a question of national importance. Since the war, however, the attitude of those responsible for the government of the country in regard to this question has changed considerably. The losses due to the submarine, and the shortage of steamship accommodation, have appreciably diminished the imports of timber, with the result that we are now turning to home sources to make up for the deficiences.

The two problems that will have to be solved before we can depend entirely upon our own resources were set out by Mr. E. P. Stebbing in a lecture which he delivered at King's College. The questions are (*a*) where to get the timber we shall require during the next forty years, and (*b*) the immediate afforestation of the waste lands in the United Kingdom. Mr. Stebbing expressed the opinion that we should have to rely upon Canada and Russia for our future supplies of soft woods. He disapproved of small tentative schemes of afforestation. This, in his view, would not enable us to depend upon the major portion of our supplies of home-grown timber, and he expressed the further opinion that unless the afforestation problem is conceived on bold lines, it would result in a useless waste of money.

Just as in the case of timber and other metallic materials the bulk of our supplies can be obtained by the development of the natural resources of the Empire, so in the case of metallic materials can our independence be firmly secured. The example of tungsten furnishes a striking and instructive illustration of the neglect to utilise the resources of the Empire or to work in our own territory the minerals won under the British flag. Under the stress of war conditions the importance of tungsten as an essential ingredient in the manufacture of tool-steel and as a corner-stone of modern engineering is now fully realised in this country. Much still remains to be known about the properties of this element and its uses, and Mr. Julius L. F. Vogel has performed a public service in presenting an account of tungsten at a lecture at King's College, where there are also a number of specimens of the metal to be seen. The problem of preparing pure tungsten, although one of commercial importance, was considered too small to justify a separate establishment for the industry, with the result that it was left to certain German chemical and metallurgical works to deal with the problem. Complete investigation laboratories were equipped, well-fitted works erected, and ample funds provided to develop a suitable process and put it into operation, and before long steel-makers were offered tungsten powder containing 95 to 96 per cent. of pure tungsten practically free from deleterious impurities. In course of time a still higher grade tungsten was supplied, containing up to 99 per cent. of the pure metal. Attempts to establish the manufacture of tungsten in this country resulted in the production of an article of satisfactory quality, but the scale of manufacture, local conditions, and intermittent ore supply made competition with the powerful German producers impossible. If the tungsten industry has at last been permanently established in this country, it is due in no small measure to the efforts of Mr. Vogel, who is prominently connected with the works at Widnes, which have been delivering tungsten since July, 1915, without intermission.

Even in the development of sources of energy for our industry there is immense scope for the application of scientific knowledge and method. We know, for example, that one cubic foot of water per second falling 11 ft. will develop one horse-power in any modern turbine. What use can be made of this energy? Mr. A. Newlands, engineer-in-chief of the Highland Railway, showed in the course of a paper read at the exhibition not only that the development of our water resources will provide us with the energy that we require, but also that its proper development is to some extent bound up with the re-organisation of our industrial life. Cheap power and a greatly extended use of it are imperative necessities, and the continued neglect of the water-power possibilities of this country is a very serious economic waste. In the latest Census of Production Report it is shown that while the total horse-power of industrial engines in the United Kingdom is approximately ten and a half millions, of this only 178,000 h.p., or 1·6 per cent., is represented by water-power. In the opinion of Mr. Newlands, we could easily draw upon water for one to one and a half million horse-power, or more than 10 per cent. of our requirements. A comparison of the percentage of available water-power utilised in Great Britain with that of other countries furnishes a very impressive reminder of the undeveloped state of that industry here. Germany utilises 43·4 per cent. of the water available and capable of development; the United States, 24·9 per cent.; France, 11·6 per cent.; Great Britain, only 8·3 per cent. It is estimated that while there is available for development from water-power in Great Britain 10·9 h.p. per square mile of area, only 0·91 h.p. is actually used.

Mr. Newlands is of the opinion that the place of water-power in industry lies in the utilisation of it so far as possible in territory where industrial activity can be re-created or where none has existed hitherto. This raises a very important sociological problem which it is desirable that our men of science and engineers should consider seriously. The energy derived from water-power can be transmitted electrically over large areas, and made available where practicable for the varied requirements of agriculture, both in field operations and in farm buildings. Here it would help to eliminate much of the drudgery of this important industry, while at the same time coming into service for the purpose of rural transport. As to industries, it is only necessary to mention the manufacture of aluminium, the electro-chemical industries, and the fixation of nitrogen to show what enormous possibilities exist in the development of these industries by the application of large power supplies which would be made available by the utilisation of water. The saving of coal, too, through the development of our water-power resources is an item the importance of which cannot be over-estimated. But this is not the only consideration, for it has distinct and far-reaching possibilities and advantages of its own; and if, as is generally believed, we must enormously increase our national production to re-establish our national position, the utilisation of water-power will be necessary.

While considering the development of resources in this country, attention must be given at the same time to the development of the resources of other parts of the Empire. We have already mentioned the case of tungsten, but there is another example of a field which awaits the application of science, and that is in the resources of West Africa. A comparison of recent statistics presented by Mr. R. E. Dennett in a lecture delivered at the exhibition does not make very cheerful reading. Up to the first six months of 1914 nearly all West African copra went to Germany. From the same territory Germany took nearly half the production of cocoa, more than two-thirds of the palm kernels, about one-eighth of the palm-oil, half of the hides, one-third of the mahogany, more than half of the ground-nuts, more than one-third of the shea-nuts, and the whole of the palm-kernel cake; in all, nearly half of the total exports from the West African Union went to Germany. The explanation of this is simple. In addition to enterprise, the Germans investigated scientifically the best methods of converting these articles into foodstuffs, etc., and, as Mr. Dennett has pointed out, "we should be greater fools than even the Germans now consider us to be if we did not take every precaution in the future to deprive the German Government of the power to procure West African products with the view of making war upon us again." For it must be remembered that not only are many of these products suitable as foodstuffs; they are also absolutely essential for the manufacture of war material. Of the many instances given by Mr. Dennett of the utilisation of these materials, a good example of the advantage of science is shown by the utilisation of waste cotton-seed as a driving power. He said:—

"In the centre of Africa, where cotton-seed is of little value owing to costly transport, the obtaining of power for driving a ginnery or any other machinery is of great importance, as the further you get into the interior, the more costly coal becomes. On the other hand, cotton-seed is, to all intents and purposes, a waste product in such places, and may well take the place of coal. The power is obtained, not from the oil, but from the seed itself, which is composed of carbonaceous matter. Cotton-seed cake or damaged cotton-seed unfit for crushing purposes is equally good material.

"Cotton-seed gas plants are composed of a brick-lined furnace, in which the seed is burnt on a grate. The air is drawn through the fire and CO_2 is produced, this afterwards being reduced to CO. The gas is then cooled and cleaned and the tar extracted by means of a centrifugal device, which causes all heavy matter to be expelled. A plentiful supply of water is needed for the cleaning process. A suction-gas plant produces exactly the amount that the engine requires. Compared with the steam-engine, the fuel used per b.h.p. is about one-half, the actual amount of coal being in the region of about 1·5 lb. per b.h.p. per hour, and cotton-seed about 4 lb. per b.h.p., including stand-by losses. The labour required to operate a gas plant is also considerably less than that required for a steam-engine of similar size."

Regarding cotton-seed as a possible edible oil to compete with coconut or palm-kernel oil, Mr. Dennett said:—"Cotton-seed oil can now be treated with hydrogen and so converted into a solid fat, and thus hardened it is already largely used to make compound lard, which in some cases contains no lard properly so-called. In this way many of the twenty-three West African oils may also possibly be used in the manufacture of margarine."

THE BRITISH GLASS INDUSTRY.

GLASS is prominent in many parts of the British Science Guild's Exhibition at King's College. It is one of those commodities to which little thought was given while 80 per cent. of our requirements were imported from abroad; but we learn to appreciate things which we have to make for ourselves, and we are learning also something of the extraordinary range of the varieties of glass and the multiplicity of uses to which it is put. In some form or other we find it in use in nearly every section of the exhibition, and we read about it in the admirable "Articles on Recent Developments" in the catalogue. In the first—referring to "Key Industries," by Prof. Gregory—we learn of the vital national importance of glass for optical and scientific purposes; and in that on "Optical Instruments," by Mr. S. D. Chalmers, that most of the types of optical glass which were formerly imported are now made in this country. Dr. Turner contributes an encouraging account of the recent development of "The British Glass Industry" generally, showing how the initial impulse came from our chemists, and how it was followed by the establishment of the Department of Optical Munitions and Glassware Supply of the Ministry of Munitions; by the foundation of the Department of Glass Technology in the University of Sheffield, with the assistance of the Department of Scientific and Industrial Research, the Ministry of Munitions, and the manufacturers; and, finally, by the formation of the Society of Glass Technology—now an important and thriving industrial association. Mr. Chapman Jones, in his contribution on "Photography," tells us of the efficiency of the cameras employed by the Air Force; and Prof. Boswell deals with the all-important subject of "Glass-making and Refractory Sands," relating how optical glasses and laboratory ware are being made successfully from British deposits.

The exhibition includes the productions of many enterprising firms which have taken up new branches of the industry. We may note especially the remarkable range of glass apparatus for chemical and bacteriological work, of which the manufacturers' associations have combined to make a most creditable display. These are practically all productions undertaken during the war, in the face of very adverse and discouraging conditions, and they bear evidence of steady improvement in both quality and technique. In optical glass Messrs. Chance Bros., Ltd., who have, most fortunately for us, kept the industry alive in the country for seventy years, present a striking exhibit of interesting specimens; while the Derby Crown Glass Co. has also entered the field in this essential "key" industry, and shows samples for various purposes. In a separate room the members of the British Lampblown Scientific Glassware Manufacturers' Association exhibit nicely finished thermometers of many kinds, as well as other graduated scientific apparatus. Messrs. Ackroyd and Best and Messrs. Moncrieff show miners' safety-lamp glasses, and the latter firm also gauge-glasses and other important requirements for acid-plant and munition purposes. We must not omit to mention the exhibits of "Vitreosil" plant of the Thermal Syndicate, and the models of transparent quartz-glass apparatus shown by the Silica Syndicate, both excellent examples of industry thoroughly British from their inception.

In connection with the revival of the British glass industry represented in the exhibition, the following quaintly worded passage from a little volume on "The Arts and Manufactures," by William Enfield, "assisted by eminent professional gentlemen" (London: Printed for Thomas Tegg, No. 111, opposite Bow Church, Cheapside, 1809), is of interest:—

"It is to be greatly regretted, that the very important manufacture of glass, should not be so cultivated and encouraged in Great Britain as to prevent totally the importation of foreign; whereas, from the production of sand, lead, and coals, in our own country, we may make the best sorts of glass much cheaper than can be done elsewhere; we yet, however, take looking-glass plates of France, to the amount of a very considerable sum; some window-glass of the Dutch; and the German drinking-glasses for water, with gilt edges and ornaments, are now coming again extremely into fashion. The causes of this demand for foreign commodities, which are, or might be better, and cheaper manufactured here, are various; and the displaying of them not being a proper part of our business at present, we shall wave [*sic*] it, and only intimate, that the tax laid upon glass (against all the principles of good policy) has greatly corroborated them, as well as checked a growing exportation of some articles, which would probably, in time, have been of very great consequence to our commerce."

The window-tax was abolished in 1851, and house duty substituted for it. The tax no doubt affected glass production generally, but, in any case, it is quite time that we made an endeavour to supply our own requirements, and every effort should be made to assist our manufacturers to attain that object.

HIGH-TEMPERATURE APPLIANCES.

DURING the war period, when industries are being conducted on more scientific lines, when in every detail of operation the utmost care must be exercised, the exact control of temperature becomes imperative in processes of such paramount importance as metal pouring, annealing, hardening, etc. Within recent years the methods of pyrometry have reached a high order of accuracy. Many pyrometers, too, combine with moderate accuracy a simplicity and a robustness of construction which eminently adapt them for works' use, and their rapidly extending application is as important a feature of modern progress as the attainment of the highest accuracy in a limited number of instruments. In a works recently instanced no fewer than 50,000 high-temperature determinations are made weekly with electrical and optical pyrometers, this work fully engaging the attention of sixty assistants.

Progress of this nature can scarcely be adequately reflected in an exhibition such as that arranged by the British Science Guild at King's College, and the pyrometer exhibits cannot be said to be fully representative of modern work. The enormous demand for such instruments no doubt precludes their availability for exhibition purposes. In every case their installation results in a marked improvement in the quality and uniformity of products, and economies thus effected soon cover the cost of installation.

Among the exhibits relating to the control of temperature, one of some interest is an electrical thermostat developed at the National Physical Laboratory by Messrs. Haughton and Hanson. In this apparatus an accurately controlled temperature may be maintained over prolonged periods, as is often required in metallurgical research. Thus 1000° C. is maintained to within 1° C.

Many industrial operations exceed temperatures at which thermo-electric and resistance pyrometers are available. Radiation and optical pyrometers are then in demand. For works' purposes direct readings are desirable, and this condition is easily attained. The wedge pyrometer exhibited by the Optical Pyrometer Syndicate is of a simple type, capable of being placed with safety in the hands of an intelligent workman. By means of a small telescope the image of the hot body emitting visible rays is focussed through a wedge-shaped prism of dark glass, the prism being adjusted until the image just disappears. The instrument is calibrated so that the position of the prism indicates the temperature under observation. Ordinarily arranged to cover a temperature difference of 400° C., a wider range of 800° C. is possible, and thus a pair of instruments with ranges of 550°–1300° C. and 1250°–2100° C. respectively, safely cover the temperatures of a wide range of operations.

A gratifying feature of the pyrometers now in use is the large proportion of British manufacture. This achievement is due to the close co-operation of those familiar with high-temperature research, thoroughly acquainted with the essentials of design and the limitations of the various types of instruments, with the manufacturers who are responsible for the accurate reproduction of the designs of the experts. The time is surely not far distant when the few special forms of instrument emanating from Germany will have been entirely replaced by improved forms of British manufacture.

Turning now to the range of furnaces in which many types of operation essential to technical work are carried out, the extensive use of gas heating is well known. For fuel economy, clean and perfect combustion, and exact control of temperature, gas-heated furnaces present many advantages for both melting and tool-makers' purposes. The latter furnaces are frequently of the twin muffle type. One example is shown by the Monometer Manufacturing Co., and is designed for hardening high-speed steel. A feature of the furnace is the patent automatic heat regulator to give close and continuous control of the temperature in both chambers. The furnace consumes town gas with air at 2-lb. to 4-lb. pressure. The same firm also shows a ladle furnace and a die-casting machine, each fitted with a self-acting heat regulator, by which the desired temperature can be controlled. Fuel economy is thus effected, and the prevention of overheating—and with it the many errors consequent thereon—is ensured. The Davis Furnace Co. has on exhibit a portable tool-makers' outfit, which includes an oven capable of attaining a temperature of 1350° C.

The requirements of modern thermal operations are opening up the possibilities of electrically heated furnaces. These carry the advantages of compactness, simplicity of design, and the great ease with which exact temperature control can be effected. An example is seen in the Wild-Barfield muffle furnace manufactured by Messrs. the Automatic and Electric Furnaces, Ltd., and used for hardening and similar operations. Furnaces of the salt-bath type are also in use, and are fitted with pyroscopic detectors, compensators, and galvanometers.

Among other exhibits of thermal interest may be noted amorphous carbon electrodes of large diameter and more than 6 ft. in length, with screwed ends which admit of a continuous feed. Electrodes of this type are extensively used in electro-metallurgical operations such as the manufacture of calcium carbide and ferro-alloys. Messrs. Hadfields, Ltd., exhibit a large temperature chart indicating many of the important metallurgical temperatures based on the latest available data.

WATER-POWER AND ITS UTILISATION.[1]

THE *World's Present Power Demand*.—It is impossible to estimate, with any pretensions to accuracy, the power now being used in the various countries of the world.

Independent estimates,[2] based on such data as are available, tend, however, to show that it is of the order of 120 million h.p., made up approximately as follows:—

World's factories, including electric lighting and street railways ...	75	million h.p.
World's railways	21	,, ,,
World's shipping	24	,, ,,
Total	120	,, ,,

This includes all steam-, gas-, and water-power.

[1] Abridged from the Preliminary Report of the Committee of the Conjoint Board of Scientific Societies appointed "to report on what is at present being done to ascertain the amount and distribution of water-power in the British Empire"

[2] "The World's Supplies of Fuel and Motive Power," Hawksley Lecture Inst. Mech. Engineers, 1915, Sir Dugald Clerk. "Natural Sources of Energy," A. H. Gibson: Cambridge University Press, 1914.

Of the 75 million h.p. used for factories and general industrial and municipal activities, a rough approximation of the most probable distribution would appear to be :—

—	United Kingdom	Continental Europe	United States	British Dominions and Dependencies	Asia and S. America
Millions of h.p.	13	24	29	6	3

An estimate by the Dominion Water-Power Branch of the Canadian Department of the Interior outlines the hydraulic situation of the various countries as follows :—

Country	Area (square miles)	Population (Latest available figures)	B.-horse-power available (1915 estimate)	B.-horse-power developed (1915 estimate)	Per cent. utilised	Horse-power per sq. mile of area	
						Available	Developed
United States ...	3,026,600[1]	92,019,900[2]	28,100,000	7,000,000	24·9	9·3	2·31
Canada "A"[3] ...	2,000,000	8,033,500	18,803,000	1,735,560	9·2	9·40	0·86
Canada "B"[4] ...	927,800	8,000,000	8,094,000	1,725,000	21·0	8·74	1·83
Austria-Hungary	241,330	49,418,600	6,460,000	566,000	8·8	26·8	2·34
France	207,100	39,601,500	5,587,000	650,000	11·6	27·0	3·14
Norway	124,130	2,302,700	5,500,000	1,120,000	20·4	44·3	9·02
Spain	194,700	18,618,100	5,000,000	440,000	8·8	25·7	2·27
Sweden	172,900	5,521,900	4,500,000	704,500	15·6	26·0	4·08
Italy	91,280	28,601,600	4,000,000	976,300	24·4	43·8	10·7
Switzerland ...	15,976	3,742,000	2,000,000	511,000	25·5	125·2	32·0
Germany ...	208,800	64,903,400	1,425,000	618,100	43·4	6·8	2·96
Great Britain ...	88,980	40,831,400	963,000[5]	80,000	8·3	10·9	0·91
Russian Empire[6]	8,647,657	182,182,600	20,000,000	1,000,000	5·0	2·3	0·12

1 Excluding Alaska (area about half million sq. miles).
2 1911 census+12 per cent.
3 Canada "A": 2,000,000 sq. miles taken as the area treated in the Conservation Commission's estimate of available water-power; and the area which we may expect to see fairly thickly settled during the next few decades. This includes the area indicated by "B" and the 8,000,000 population of "B." The area of the whole Dominion is 3,729,750 sq. miles. The powers given are a 1917 estimate.
4 Canada "B" refers to the presently most thickly populated portion of the Dominion.
5 The estimate for Great Britain is almost certainly much too high.
6 A recent estimate by the Ministry of Ways of Communication (*Electrical Review*, February 22, 1918).

From this it appears that between 15 and 16 millions of the world's industrial horse-power is at present developed from hydraulic resources. The following table shows approximately the hydraulic power developed in the various regions, and also the ratio of this to the total industrial horse-power, excluding railways :—

—	United Kingdom	Continental Europe	United States	Colonies
Millions of h.p. ...	0·08	6·5	7·0	2·0
Percentage of total industrial h.p.	0·6	27·0	24·0	33·0

Perhaps the most interesting feature of these tables is the extremely small proportion of available hydraulic power developed in the United Kingdom. It is the most backward in this respect of all the countries listed, except Russia, and its 8·3 per cent. compares very unfavourably with the 43·4 per cent. of Germany.

Nitrogen Fixation.—In the utilisation of atmospheric nitrogen for the production of nitric acid and the manufacture of nitrates, great developments have taken place during the last decade, and in Norway alone more than 400,000 e.h.p. is now absorbed in its production. The world's annual consumption of nitrogen in its various combinations is about 750,000 tons, representing a value of about 50,000,000*l.*, and this demand is increasing yearly. Four-fifths of this supply has been produced hitherto from natural nitrate deposits, but in view of the rapid depletion of these deposits, and of the diminution in the fertility of most of the great wheat- and cotton-growing areas of the world, the production of artificial fertilisers by one or other system of nitrogen fixation must, in the near future, become a question of national importance.

At the present time the world's consumption of fertilisers amounts to close upon 6,000,000 tons per annum, and this will probably be doubled within the next twenty years. To-day the efficiency of the electrical production is low, amounting in the case of calcium nitrate to about three-quarters of a ton per e.h.p.-year. By adopting the cyanamide process the consumption of energy may be cut down to about one-fourth, but even in this case the production of the equivalent of 12,000,000 tons of fertilisers per annum would require 4,000,000 continuous e.h.p.

It is estimated that the 200,000,000 acres of arable land in Canada alone may ultimately require some 10,000,000 tons of nitrates per annum to maintain their fertility, and this in itself would necessitate the absorption of an appreciable portion of the whole hydraulic energy of the Dominion.

Cost of Hydraulic Power.—An examination of some 120 European installations shows that for large installations of upwards of 10,000 e.h.p. the minimum cost of the hydraulic works is 8·4*l.* per h.p. installed, and the maximum 79·6*l.* per h.p. For the majority of the installations the cost lies between 25*l.* and 45*l.* The cost of the electrical generators, switchboards, etc., and transmission lines also varies greatly, ranging from 1·25*l.* to 28·4*l.* per h.p., while the cost of the turbines ranges from 4*l.* to 8*l.* per h.p. The working costs vary between 1·3*l.* and 6·8*l.* per e.h.p.-year, with an average value of 3*l.* From these figures it appears that on the average, making an allowance of 15 per cent. for interest and depreciation the cost per e.h.p. per annum is in the neighbourhood of 10·5*l.*

In many installations, however, the cost is very much less than this. The Ontario Power Company, for example, is able to supply power to the Hydro-Electric Commission of Ontario at 1·8*l.* per e.h.p. per annum. It is estimated that many of the large powers in Canada can be developed at a total cost, including all generating machinery and transmission lines, ranging from 12*l*. to 20*l*. per e.h.p., in which case the cost per h.p. per annum should not exceed 2*l*. to 3*l*.

Resources of Canada.—Canada is exceptionally fortunate in the extent and distribution of its water-powers. Extending over a belt of several thousand miles in length, from Alaska to Labrador, and over a width of several hundred miles, there is an almost continuous network of lakes and rivers.

The following table shows how general is the distribution of water-power throughout the Dominion:—

Province	B.-horse-power		Per cent.
	Available	Developed	
Nova Scotia	100,000	21,412	21·4
New Brunswick ..	300,000	13,390	4·5
Prince Edward Island ...	3,000	500	16·7
Quebec	6,000,000	520 000	8·7
Ontario	5,800,000	789,466	13·6
Manitoba	3,500,000	76,250	3·1
Saskatchewan		100	
Alberta		32,860	
British Columbia ...	3,000 000	269,620	9·0
N.W. Territories, Yukon	100,000	12,000	12·0
	18,803,000	1,735,598	9·2

Resources of Australia.—Though comparable in area with the United States, there has yet been no notable hydro-electric development in Australia. Except on the east coast, the topography is too flat or the rainfall too low to provide the necessary conditions. Some of the large irrigation schemes are capable of being utilised for power production, but the aggregate of such possible power is small.

The only possibilities of considerable powers are to be found in the rivers draining the Great Dividing Chain of the east coast.

The aggregate power suggested as being capable of economic development in the Great Dividing Chain is as follows:—

Australian Alps	300,000	to 500,000	h.p.
Blue Mountains	25,000	to 50,000	,,
New England Range ...	200,000	to 500,000	,,
Cairns district	100,000	to 250,000	,,
Total	625,000	1,300,000	

Conclusions.

The main conclusions to be drawn from the evidence available to the committee are:—

(1) That the potential water-power of the Empire amounts in the aggregate to at least 50 to 70 million horse-power.

(2) That much of this is capable of immediate economic development.

(3) That, except in Canada and New Zealand, and to a less extent in New South Wales and Tasmania, no systematic attempt has as yet been made by any Government Department to ascertain the true possibilities of the hydraulic resources of its territories, or to collect the relevant data.

(4) That the development of the Empire's natural resources is inseparably connected with that of its water-powers.

(5) That the development of such enormous possibilities should not be left to chance, but should be carried out under the guidance of some competent authority.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Institution of Naval Architects' Scholarship for 1918 has been awarded by the Council to Mr. H. W. Nicholls, of Chatham Dockyard. The scholarship is of the value of 100*l*. per annum, and is tenable for three years.

A COPY of the calendar for the session 1918–19 of the McGill University, Montreal, has been received. Its 377 pages give very full details of the varied courses of instruction provided, not only for graduation in the more ordinary university faculties, but also for non-graduate students desiring to study other branches of learning. It is possible here to refer only to a few of the expedients adopted to assist needy students of ability. Particulars are given of loan funds which have been established for the purpose of aiding students who, upon the completion of their second or later year's work, require assistance to enable them to finish their course of study. Satisfactory arrangements are made to secure the eventual repayment of the loans. The provision of scholarships, exhibitions, and prizes is on a generous scale, and the needs of every class of student seem to have been thought of, and means taken to give due recognition to excellence in whatever line of work has been followed.

THE prospectus of the University courses in the Municipal College of Technology, Manchester, for the forthcoming session describes fully the facilities which the college offers for systematic training in the principles of science and art as applied to mechanical, electrical, municipal, and sanitary engineering, as well as to architecture, the building trades, the chemical and textile industries, and to photography and the printing crafts. Not only does the college provide the necessary courses for students who desire to graduate in the faculty of technology, but it caters liberally for more advanced study and research. A new degree of Doctor of Philosophy has been instituted with the object of encouraging research among suitable graduates from approved universities. It is interesting to note in this connection that the governing body of the college is prepared to award a limited number of research scholarships in technology, each of a value not exceeding 100*l*. The prospectus gives full particulars also with regard to the entrance scholarships available at the college.

A NEW departure is announced by the Royal School of Mines, which is now a constituent part of the Imperial College of Science and Technology, in the institution of a new associateship of the school in mining geology. The curriculum has been designed under the guidance of a number of the leaders of the mining world in England, who constitute the advisory committee of the school, and also in consultation with many successful mining geologists and mining engineers. The students receive, in the subjects essential to them, the same training as the regular mining students of the school, comprising, for example, surveying, principles of mining exploitation of mines, and mine sampling and valuation, but in addition they spend practically an entire year on the branches of geology and mineralogy specially applicable to mining, concerning which much knowledge has been acquired and published in recent years. In addition to a grounding in the necessary parts of mineralogy and petrology, special attention is devoted to structural, stratigraphical, engineering, and mining geology. The course is an eminently practical one, and comprises work in the laboratory and in the field, the latter including not only instruction and practice in geological surveying, but also a series of visits under guidance in order to study areas chosen as illustrating different types of mineral deposits. The course has also been so arranged that it can be taken in a post-graduate year by those who have already completed the associateship in the subjects of mining.

THE main heads of the School Teachers' Superannuation Bill, which Mr. Fisher hopes to introduce in the House of Commons in the autumn, have been published as a Parliamentary paper (Cd. 9141). The Bill will bring within one comprehensive system of State pensions, on a non-contributory basis, both certificated and uncertificated teachers in elementary schools, as well as the teachers in all other schools aided by the Board of Education, including those training colleges which are not departments of universities. The benefits will consist of annuities, together with lump sums, for those who retire at the age of sixty or later after thirty years of service, and for those who retire disabled after ten years' service; and of gratuities payable on the death of a teacher in service after five years of service. No difference will be made between the sexes in the conditions of pension, except that in order to provide for women teachers leaving the profession to be married and afterwards returning to it, provision is made for the substitution of twenty years' service for thirty as a condition of pension in such cases. Pension service will, as a rule, cease at sixty-five. Service to be pensionable must be full-time service in schools which are grant-aided at the time of service, or in secondary schools which, though not grant-aided at the time, become grant-aided within five years of the passing of the Bill. Power is reserved to the Board of Education, however, to reckon as pensionable service a limited amount of service in certain other schools rendered before the commencement of the operation of the Bill. Other matters dealt with in the Bill include medical examination for future teachers before admission to recognised service and the power to withhold or reduce benefits in case of misconduct.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 12.—M. P. Painlevé in the chair.—J. **Boussinesq**: Confirmation of the principle of the approximate theory of punching for a thick block.—G. **Bigourdan**: The observatories of the Harcourt College, to-day the Lycée Saint-Louis.—H. **Douvillé**: The strata containing Orbitoids in North America.—E. **Ariès**: The saturated vapour pressures of bodies containing a large number of atoms in the molecule. The formulæ developed in previous papers for substances containing from one to eight atoms in the molecule are now applied to pentane, hexane, heptane, and octane, and the calculated vapour pressures compared with the experimental results of Young and of Young and Thomas.—J. **Comas-Solà**: Stereoscopic studies of stellar currents. Two pairs of negatives, taken 1912-18 and 1916-18, have been examined by the stereoscopic method, and show that for stars of the first ten magnitudes a proper motion in the form of a current is general.—G. **Fayet**: The third appearance of the periodic Borrelly comet. This was seen at Nice on August 6-7.—M. **Baillaud**: Note on the same. Positions given for August 7 and 10.—R. **Combes**: The immunity of plants with regard to the immediate principles which they elaborate. The saponine of *Agrostemma githago* (agrostemmasaponine) in concentration as low as 1 : 10,000 behaves as a poisonous substance for the roots of plants not producing this glucoside (pea, buckwheat, radish), but exerts no toxic action even with a much higher concentration, 1 : 100, on the roots of *Agrostemma githago*.—J. **Dumont**: The aqueous reserves of the soil in periods of drought. Determinations of moisture in soil after drought were made at depths from 0 to 80 cm. from the surface, and for different crops with and without manure.—F. **Maignon**: The influence of fats on the toxic power of the food proteins: their *rôle* in the utilisation of nitrogenous materials. Applications to therapeutics.

SYDNEY.

Royal Society of New South Wales, June 5.—Mr. W. S. Dun, president, in the chair.—C. D. **Gillies**: The spine mode of *Centropyxis aculeata*, Stein. Material for the investigation of the spine variation in the test of this Rhizopod was obtained from six different localities in Queensland. It was found that the spine-frequency polygons were unimodal, and that the empirical mode varied from 3-5. From May, 1916, to December, 1917, material was collected at monthly intervals from the Brisbane Botanic Gardens. The modal value of the polygons was 3, hence for this locality the mode is a constant.—R. W. **Challinor**, E. **Cheel**, and A. R. **Penfold**: A new species of Leptospermum and its essential oil. From evidence accumulated over a period of six or seven years, including the cultivation of a number of plants and the chemical investigation of the essential oil, which is shown to consist principally of the two aldehydes, citral and citronellal, the authors have proved that at least one more of our native tea-trees is new to science, and give the name *Leptospermum citratum* to this new species.—C. **Laseron**: Notes on some Permo-Carboniferous Fenestellidæ, with description of new species. The fossil polyzoa of Australia, though abundant in many formations, are as yet but little known, and this paper deals with ten more or less common forms in the Permo-Carboniferous rocks, mostly in the Hunter River district. Six new species and several old types are described.

July 3.—Mr. W. S. Dun, president, in the chair.—J. H. **Maiden**: A contribution to a history of the Royal Society of New South Wales. The earliest recorded effort to form an improvement society was in the year 1818, when Judge-Advocate Wylde's attempt to form an agricultural society failed because Governor Macquarie demanded the admission of emancipists. In December, 1821, Governor Brisbane formed a scientific club under the name of the Philosophical Society of Australasia. Some of the papers read were printed by Barron Field, while the bronze plate at Kurnell celebrates the foundation of this society and the jubilee of Capt. Cook's visit. This was succeeded by the agricultural society in the following year, which also became a horticultural society in 1826. The author showed the direct descent of the Royal Society of New South Wales from the Australian Philosophical Society, founded January 19, 1850. On July 30, 1855, it was resuscitated under the name Philosophical Society of New South Wales, and received its present title on December 12, 1866.—Prof. H. S. **Carslaw**: Note on the theory of a simple progressive tax, and its bearing on the Federal income-tax schedules. This paper dealt with the system of tax in which the amounts paid on each successive pound form an arithmetical progression, and incidentally showed that without material change in the incidence of the tax such a system could be substituted for the complicated schedules of the Federal Income-Tax Acts.

MELBOURNE.

Royal Society of Victoria, June 13.—Mr. J. A. Kershaw, president, in the chair.—J. T. **Jutson**: The sand ridges, rock floors, and other associated features at Goongarric, in sub-arid Western Australia. This paper deals with the westerly trend of the lake basins, the cutting back of the hard, rocky bluffs, and the development of parallel sand ridges with well-marked intervening valleys, running in an east-west direction. This latter feature has not before been discussed in detail.—R. A. **Keble**: The significance of lava residuals in the development of the Western Port and Port Phillip drainage systems. The older and newer basalts of Victoria flowed down the valleys, partly occupying or completely submerging them. Subsequent erosion took place on the softer flanking rocks in the case of the confined lava-fields. In the case of the extensive lava-fields erosion proceeded along the pre-basalt watersheds, since they were the first to be exposed by vertical erosion, and afforded the line of least resistance. It is submitted that it is possible to reconstruct from these data the pre-basalt stream systems.—F. **Chapman**: The age of the Bairnsdale Gravels, with a note on the included fossil wood. The sheet of gravel covering the uplifted coastal plain of the Victorian coast from the hill-ranges of South Gippsland on the west to Cape Howe on the east is described, and shown to be of Wernikooian (Upper Pliocene) age. Its terrestrial origin is proved by the physiography of the surrounding country and the nature of the deposits, whereas, if of marine origin, the sand would have been largely removed by continuous tidal action. The included fossil (silicified) wood is referred to two types of Eucalypts, the nearest allies of which are yellow box (*Eucalyptus melliodora*) and white stringy bark (*E. piperita*). The wood is derived from an older formation, Kalimnan (Lower Pliocene) or even Janjukian (Miocene).

CALCUTTA.

Asiatic Society of Bengal, July 3.—J. N. **Rakshit**: The isolation of porphyroxine. A solution of opium in lime-water is shaken up with ether, and the ethereal extract dried over calcium chloride and evaporated; the residue thus obtained is washed with boiling petroleum, dissolved in dilute hydrochloric acid, filtered, the filtrate made alkaline with sodium bicarbonate, again filtered, and the alkaline filtrate extracted with chloroform. On evaporation of the chloroform extract crude porphyroxine is obtained, which, when crystallised from alcohol, gives the pure alkaloid as a pinkish-brown powder.—M. N. **Saha**: A new theorem in elasticity. From the equations of motion of an elastic system, a new theorem has been deduced expressing the difference between mean kinetic and potential energies. The theorem is analogous to Clausius's Virial theorem in the kinetic theory of gases, and appears to be of great promise for the relative estimation of kinetic and potential energies in various cases of vibration.—M. N. **Saha** and S. **Chakravarti**: The pressure of light. A series of experiments which were recently carried out at the Sir T. N. Palit Laboratory of Science for demonstrating, and qualitatively estimating, the pressure of light has been described. The apparatus is a modification of Hull's apparatus for measuring the pressure of light, and is so designed that all disturbing effects have been eliminated. Previous workers used the arc as the source of light, but this being very unsteady, a tungsten filament lamp of 3000 c.p., which gives almost as intense a light as the arc and is absolutely steady, has been used. The observed and calculated pressures are in good agreement.—G. de P. **Cotter**: The geotectonics of the Tertiary Irrawaddy basin. It has been found necessary, through recent field work in the Minbu and Pakokku districts, to modify previous ideas of the Tertiary history of Burma. The author believes that there is no unconformity, except of an entirely local character, between the Pegus and Irrawaddys of the Irrawaddy basin. The supposed unconformities of Yenangyat and Minbu are partly to be explained as missing beds cut out by fold faults. There is evidence of Pleistocene and recent upheaval in the Irrawaddy basin.—E. W. **Vredenburg**: Considerations regarding a possible relationship between the charnockites and the Dharwars. Attention is directed to the possibility of regarding the charnockites as metamorphosed representatives of the igneous members of the Dharwars.—E. W. **Vredenburg**: Note on the occurrence of *Dolium variegatum*, Lamarck, at Maskat, with considerations on its geographical distribution at the present day and in former geological times. *Dolium variegatum*, Lamarck, hitherto known as a recent shell only from Australia, has been noticed in the Indian Museum amongst a collection of shells from Maskat. In a fossil condition it is known from the Upper Tertiary of Java and of the Makran, indicating that its distribution, discontinuous at the present day, was continuous in former geological times.

BOOKS RECEIVED.

Organic Chemistry for Advanced Students. By Prof. J. B. Cohen. Second edition. 3 parts. Pp. viii+366; vii+435; vii+378. (London: E. Arnold.) 54*s.* net.

An Introductory Treatise on Dynamical Astronomy. By Prof. H. C. Plummer. Pp. xix+343. (Cambridge: At the University Press.) 18*s.* net.

Alternating-current Electrical Engineering. By P. Kemp. Pp. xi+494. (London: Macmillan and Co., Ltd.) 17*s.* net.

A History of Chemistry. By Prof. F. J. Moore. Pp. xiv+292. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12*s.* 6*d.* net.

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THURSDAY, SEPTEMBER 12, 1918.

INDUSTRIAL CHEMISTRY.

I.

(1) *The Manufacture of Intermediate Products for Dyes.* By Dr. J. C. Cain. Pp. xi+263. (London: Macmillan and Co., Ltd., 1918.) Price 10*s*. net.

(2) *The Alkali Industry.* By J. R. Partington. Pp. xvi+304. ("Industrial Chemistry.") (London: Baillière, Tindall, and Cox, 1918.) Price 7*s*. 6*d*. net.

(3) *Edible Oils and Fats.* By C. A. Mitchell. Pp. xii+159. ("Monographs on Industrial Chemistry.") (London: Longmans, Green, and Co., 1918.) Price 6*s*. 6*d*. net.

CHEMICAL industry in this country is slowly, but let us hope surely, coming into its own. Public interest has been directed to it, and its importance to the nation has been recognised, though there is still much leeway to make up in this respect. The industry also is finding itself from within; combination and association are taking the place of antagonism and aloofness, and before long the industry will speak with one voice to the public and to the Government on matters which concern it. One of the minor indications of progress is the increase both in the quantity and quality of our chemical publications, the enlarged Journal of the Society of Chemical Industry being a particularly valuable asset to the industry. The movement to produce text-books of industrial chemistry in English is of prime importance for the future of the industry; in the past we have been far too prone to resort to German works or their translations. Indeed, had it not been for the fortunate completion of Thorpe's "Dictionary of Chemistry" just before the war, English chemical workers ignorant of German would have been considerably handicapped.

An industrial text-book may be judged from several standards, depending on whether it aims at giving a complete account of modern practice in the particular industry or limits its scope to describing chemical theories and their applications to that industry. It may seek to be a work of reference to all engaged in the industry, or merely an introduction to beginners, or it may aim at stimulating progress by outlining the applicability of the most modern discoveries. The first type of book can be produced only by a writer who has had intimate experience in the industry and is free to put his information on record for the use of others. Normally, the majority of those possessing such knowledge are either pledged not to disclose it, or professionally engaged as consultants. The second type of book is more usual, and is naturally much more complete on the theoretical than on the practical side; it must be held to be successful if it encourages a greater knowledge of chemical science and scientific method and leads to progress in the industry.

(1) Dr. Cain is one of the few who are qualified to speak with authority on both the technical and chemical sides of the production of coal-tar colours, and not only is his book on the intermediate products certain to become the standard work on the subject, but also, what is more important, it should save an immense amount of time and money to those actually engaged in the industry. It has been pointed out at more than one shareholders' meeting lately that the intermediates are even more important than the dyes themselves, and that the provision of adequate plant for their manufacture is the first step in the establishment of a British dye industry. The intermediate products are so numerous, and so much depends on their cheap production, that it is quite irrational for each competing firm to manufacture its own requirements, and it is for this reason more than any other that it is desirable to establish a combine of the colour-making firms so as to manufacture intermediates in quantity, and therefore cheaply, at one or more specially equipped large works, and convert these to the finished dyestuffs at the existing smaller establishments.

Dr. Cain aims at providing in a convenient form detailed information as to the preparation of intermediates, the most trustworthy method of manufacture of each substance being recorded. Both the pure chemistry of the subject and chemical engineering details have been omitted. The chief chemical reactions employed—viz. nitration, nitrosation, halogenation, sulphonation, reduction, oxidation, fusion with alkali, hydrolysis, amidation, alkylation, acylation, condensation—are dealt with in the order enumerated.

This is not the place for any criticism in detail, which in any case must be a matter of personal opinion, and Dr. Cain's name is sufficient guarantee that no pains have been spared to render the work complete in every detail. Progress in this, as, indeed, in most branches of industry, has been gradual; perhaps at the moment the most marked trend is in the direction of the increased use of catalytic agents; there is also a great future for electrical energy, particularly in connection with oxidation and reduction. Oxidation in particular is to-day brought about by cumbersome and costly methods in comparison with what may be expected when it is possible to make use of atmospheric oxygen in conjunction with a catalyst.

(2) Mr. Partington's book, though entitled "The Alkali Industry," really deals with acids, alkalis, chlorine, and potassium salts, and practically half of it is devoted to nitric acid and ammonia, particularly the modern methods of their manufacture, which are being so much discussed at the present time. It forms one of a series of volumes, edited by Dr. Rideal, designed to show how chemical principles have been applied and have affected manufacture. The treatment is certainly novel, and it appears to the present re-

viewer to be successful in that it provides a book which is far more readable than the ordinary text-books on the subject. Naturally, the author cannot hope to be in practical touch with so wide a field, and in his efforts to secure the necessary condensation somewhat unequal treatment has resulted; indeed, the first half of the book is far too condensed. In consequence, there are numerous points of detail which might be criticised adversely, and to this extent it falls to give an accurate picture of the industry. But such criticism is of minor importance as compared with the potential power of the work to stimulate interest, and it should certainly be placed in the hands of every process manager and chemist and of all students who wish to enter chemical industry. They cannot fail to read it and feel that there is still progress to be made in their processes, and that the chemical theory even of such well-worn manufactures as acid and alkali making has made great developments since the application of physical chemistry was understood.

So much interest attaches to-day to nitric acid, the importance of which in time of war and, it is to be hoped also, in time of peace to the nation is at last being understood, that the author may be forgiven for expanding on this subject. Quite apart from the future exhaustion of the deposits of Chile nitrate, once so eloquently pictured by Sir William Crookes, the invention of the submarine has introduced new problems into the transport of this material in time of war. The problem of the fixation of atmospheric nitrogen has been solved in Germany, and its solution here is, of course, only a matter of time. The problem was one demanding huge expenditure and prolonged experiment, and not commercially attractive to business undertakings hampered by unintelligent taxation; it is essentially national in character, and must be undertaken with State assistance, as it is by no means certain that under peace conditions the synthetic product can compete with the natural.

On account of the difficulties attending transport, acids are necessarily made close to the place where they are used, and consequently there are a large number of small manufacturers, many of whom are working on too small a scale to be economically efficient. The placing of this industry upon an economic basis is one of the many post-war problems which are already receiving attention. The alternative processes for the synthetic production of ammonia and nitric acid are discussed at length by Mr. Partington.

(3) Mr. Mitchell's book is of a somewhat different type from that of those already considered. It belongs to Sir Edward Thorpe's series of industrial monographs, which aim in particular at showing how fundamental and essential is the relation of principle to practice. Mr. Mitchell's object is to give a concise outline of the chemical composition and properties of the more important oils and fats. In this he has been successful, and the analytical sections will be found very useful, in spite of the fact that there are several satisfactory works on this section of the subject already in existence. It is more difficult, however, to justify the application of the title "industrial." A description is given of the methods of pressing and extracting oils from the crude materials, and of purifying and preparing them for food purposes; but this is very brief, and no attempt is made to discuss the many chemical problems which arise in the oil and fat industry. An altogether inadequate picture is given of the present state of the utilisation of science in the manufacture of edible oils.

The very full bibliography is one of the best features of the book; it is conveniently divided into sections. E. F. ARMSTRONG.

(To be continued.)

THE "KEW BULLETIN."

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1917. Pp. iv+349+36. (London: H.M.S.O., 1917.) Price 4*s.* 6*d.* net.

THE present volume of the *Kew Bulletin* is an effective rebuke to those in authority who for a time were able to deprive the leading botanical station of the Empire of its means of publication. It would seem an axiom of common sense that a scientific institution carrying out work of prime economic importance should be able to put on record and render as widely available as possible the results of its work.

The subject-matter of the volume was published in seven parts during the past year, and comprises thirty-seven articles of varied interest. The most important is a List of Economic Plants, native or suitable for cultivation in the British Empire, which formed a double number issued last December. This list was prepared in response to a suggestion from the Committee of the Botanical Section of the British Association that a more extended and thorough study of our economic plants was a matter of national and imperial importance. The plants are classified under their uses—such as oils, gums, rubber, drugs, timber, etc.; the source is indicated, and some useful information on the product is also given, with references to publications where fuller information may be obtained.

Other articles of economic importance deal with the rubber plant, *Hevea brasiliensis*; in two are discussed the possible methods of increasing the percentage yield of rubber by seed-selection, as was done in the cultivation of cinchona, in which the percentage yield of quinine has been more than doubled. Another deals with one of the most serious diseases to which this rubber-tree is subject—bark-canker, caused by a fungus, *Phytophthora Faberi*; the writer, Mr. A. Sharples, Government mycologist in the Federated Malay States, finds that the present position is most unsatisfactory, and that the subject calls for careful and co-ordinated investigation.

A general systematic review of the species of the genus Strychnos, native in India and the East, is a valuable contribution, by Capt. A. W. Hill, to our knowledge of a genus which yields two drugs of such importance as strychnine and brucine. A useful communication on the study of plant diseases is embodied in Mr. W. B. Brierley's account of the action of the fungus *Botrytis cinerea* in causing the death of a tree of *Aesculus Pavia* in the Royal Botanic Gardens. There are also several articles embodying the results of the systematic botanical work of the Kew Herbarium; and a short note of more general interest on the flora of the Somme battlefield (abridged in NATURE of February 14 last). A number of miscellaneous notes contain items of economic or general or special botanical interest.

THE MAP AS A NEW EDUCATIONAL INSTRUMENT.

Map Work. By Major V. Seymour Bryant and Lieut. T. H. Hughes. Pp. 174. (Oxford: At the Clarendon Press, 1918.) Price 5*s.* net.

AFTER reading through "Map Work," one is drawn back irresistibly to the Introduction, in which the authors direct attention to the great value of map work both in its utilitarian and its educational aspects, and put forward a convincing claim for its inclusion in the school curriculum. Even in the narrow work of the school itself it provides material for the better understanding of mathematics, geography, and history, the last-named being a subject which demands a much greater appreciation of the relief map than is usually conceded; it gives exercise in the various branches of "drawing," and lastly it gives a rational and legitimate stimulus for the getting of accuracy.

In a wider sense it provides a congenial method of education to many for whom the ordinary school subjects hold little that is attractive when the period of adolescence is reached; and now that we are soon to be faced with a considerable influx of adolescents drawn from schools of widely differing aims and attainments, and where the examinational aspect of the various subjects has not been catered for to any great extent, it will be necesary to open up new avenues of attractiveness, and map work is certainly one of those that should have serious consideration.

Finally, there is the question of the understanding of the landscape by the ordinary layman. Generally this is held to be the domain of the artist. The foreground can be made to fit the map by most people, but the background is too often "blue hills" or "purple mountains," interesting as part of a picture, but otherwise a formless and meaningless confusion.

Map-making, in conjunction with the seemingly difficult, though really simple, art of panorama-sketching, should provide a sure method of introducing form and meaning into the landscape.

The principal aim of "Map Work" is to teach map-reading by means of map-making. Generally speaking, it bridges the gulf that exists between the very elementary work of the practical geographies on one hand, and the technical treatises of the professional surveyor and map-maker on the other. It is suitable for O.T.C.'s and cadet units and for the Oxford Senior Locals, but its value to the general student is very great indeed. Only the topographical map is dealt with, more especially the Ordnance map, but every aspect of this map is adequately and concisely treated, with special chapters on the various methods of surveying, map enlargement, field-sketching, and panorama-sketching. The appendices, which are of considerable length, give an excellent scheme of practical work with much valuable information on the use of materials and the making and use of apparatus. The whole has been read by Col. Close, of the Ordnance Survey, and is full of practical suggestions.

There is one further suggestion that might be made in regard to setting the map by the sun. If the pin or pencil used to cast the shadow be held at an angle, approximately that of the latitude, a better result is obtained than by holding it vertically.

E. J. ORFORD.

OUR BOOKSHELF.

Flora of the Presidency of Madras. By J. S. Gamble. Part ii. Pp. 201–390. (London: Adlard and Son and West Newman, Ltd., 1918.) Price 8*s.* net.

THE second part of the flora of the Presidency of Madras has followed fairly soon on the first, and, like its predecessor, has been very carefully prepared. The natural families dealt with are all those from the Celastrææ to the end of the Papilionatæ sub-family of the Leguminosæ.

As with the previous part, there is a careful description of each natural family, including details of fruits and seeds, and this is followed by a key to the various genera. Each genus likewise is furnished with a full description and followed by a thoroughly comprehensive key to the several species. These specific keys, together with the ample generic description, convey so much information about the different plants that only a line or two of description are needed under each species in addition to the particulars about its habitat, local name, etc.

The flora, it will be noticed, contains several new species which have been discovered by Mr. Gamble in his re-examination of the material at his command. The majority of the new species have been previously described in the *Kew Bulletin.*

The war has naturally hampered the preparation of the flora, and unfortunately prevented the valuable Madras collections from being sent home for examination. For this second part, however, the Calcutta specimens have been available, as well as the extensive collections at Kew and elsewhere.

For the third part Mr. Gamble proposes to work through the material available in this country, which fortunately is plentiful, as it will not be possible to receive further supplies of specimens from India. The flora is so clear and well arranged that it ought to prove of great value in Madras.

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., 1918.) Price 3*s.* 6*d.* net.

It is generally recognised that a well-planned course of chemical analysis by volumetric processes provides good intellectual and manipulative training in scientific methods. Careful thought, clear reasoning, and habits of accuracy are fostered by it. One may hope, indeed, that the time is not far distant when all students in our public schools, whether on the "classical" or on the "modern" side, will receive some such training as a normal part of their education, apart altogether from any question of a contemplated career in chemistry.

For such a course Mr. Boone's little book supplies an excellent basis. It "begins at the beginning," and leads the student on by easy but educative stages to quite advanced work. The numerous exercises are very well devised, and ample directions and explanations are given. A useful feature is the interspersed questions on points suggested by the experiments: they focus the learner's attention on matters of special importance. The experiments include the preparation of indicators and standard solutions, as well as analytical exercises; and there is a chapter, short and sufficiently simple, explaining the behaviour of indicators on the usual theory of ionic dissociation. The book can be confidently recommended.

C. S.

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., 1918.) Price 18*s.* net.

This ever-welcome annual contains the usual familiar features. The bibliographies have been brought, so far as is possible, up to date. Some of this statistical material "cannot be given," other parts are "provisional," for obvious reasons; but an effort has been made to cope with the abnormal conditions. A notable conspectus of the world's pre-war traffic in foodstuffs is provided in a folding map showing relative exports and imports. From an inset diagram we learn that the United States food production just equalled the requirements of the country; only Russia, Canada, and Argentina produced an excess; while the United Kingdom provided for just above half the required quantities of foodstuffs; though Canada is given, Australia is omitted. Among the introductory tables we note one dealing with sugar. During the war the world's supply of sugar has decreased by 20 per cent.; the production of sugar from the sugar-beet declined by more than 40 per cent., that from the cane has grown by 20 per cent., the output from Java having increased by 40 per cent.

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.]*

Auroral Observations in the Antarctic.

In Nature for April 11 last Dr. Chree reviewed Sir Douglas Mawson's paper on "Auroral Observations at the Cape Royds Station, Antarctica," and directed attention to the impression the observers received that the aurora was sometimes seen in the lower atmosphere between them and Mount Erebus. A similar statement had appeared in Shackleton's book, "The Heart of the Antarctic" (vol. ii., pp. 360–61), before Scott's expedition left for the South. As this subject is of fundamental importance in all discussions of the origin and nature of the aurora, I arranged with all members of the expedition that I should be called whenever they saw, or thought they saw, an aurora in front of Erebus.

Observations of this phenomenon were made on three occasions, and luckily I was at hand each time. I reproduce here, verbatim, the notes I made immediately after each occurrence:—

"(*a*) *May* 21, 1911.—This evening there was a bright aurora, and word came in to me that the aurora beams were clearly visible between here and Erebus. On

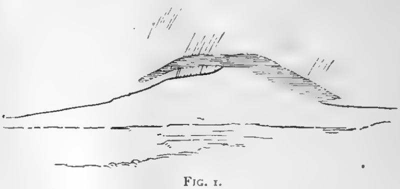

Fig. 1.

going out it appeared for some moments that this was so, but on looking closely I came to the conclusion that the effect was an illusion. The moon was low in the south, and only one or two shoulders of Erebus were lit up by it; these, however, formed more or less clear bands of light from top to bottom of the mountain. When the aurora was bright above the mountain these moonlight bands appeared as continuations of the aurora beams, and it was quite easy to imagine them in motion owing to the bright and rapid motion of the aurora itself. Dr. Wilson agreed with me in this explanation, but Dr. Atkinson, Wright, and Ponting continued to hold firmly that they had really seen the aurora in the lower atmosphere this side of the mountain.

"(*b*) *June* 22, 1911.—At about 21h. 30m. Meares reported an aurora this side of Erebus. On going out to examine, I found that the effect had disappeared; the explanation, however, seemed simple. The top of Erebus was covered with a cloud-cloak, which had an external form almost like that of the mountain. At one side, however, it was incomplete, and no doubt the aurora was seen between the cloud here and the mountain. In the dim light the outline of the cloud was taken to be that of the mountain, so that the aurora appeared to be in front of the mountain. (Fig. 1.)

"(*c*) *July* 19, 1911.—At 5 a.m. Meares reported to me an aurora in front of Erebus. On going out, there appeared to be a very bright beam of aurora low down on the foothills of the mountain, and obviously well in front of the latter. The explanation was, however, simple. The beam was not an aurora beam at all, but part of the 22° halo with the horizontal mock moon. The illusion was, however, very striking, as there were vertical beams of aurora on the left and above the halo beam." (Fig. 2.)

I have given above the actual words written at the time, as it is dangerous to describe an observation several years later, especially if a matter of opinion is concerned. I feel compelled, however, to add a few further remarks.

With regard to (*a*). it should be realised that as the moon was low, the outlines of the mountain were very indistinct, and the bands of light due to the moon shining on the shoulders were very faint. Normally, they could scarcely be seen, but when an aurora beam above the mountain coincided with a band, the eye was guided down from the beam to the band of light, which then attracted the attention and appeared as a continuation of the aurora beam.

A cloud-cloak similar to that referred to in (*b*) was often observed to cover the top of Erebus, especially after a blizzard. It frequently lay very near to the mountain, and at night its outline would not be distinguishable from that of the mountain. It was only when the gap between the mountain and the cloud, through which the aurora appeared, was observed that the presence of the cloud itself was suspected. This was an excellent illusion, and nine casual observers out of ten would have been convinced that the aurora was clearly visible in front of the mountain.

The third illusion was probably the most impressive. The mock moon, with part of the vertical circle, was formed in a mist, itself quite invisible, which lay over the foothills of Erebus. The moon was shining in a clear sky without any sign of a halo, and none but a trained observer would have connected this detached beam of light with the moon. It appeared to be much more a part of the aurora display which was taking place apparently in its immediate neighbourhood, and the conclusion reached by Meares that it was a part of the aurora was very natural.

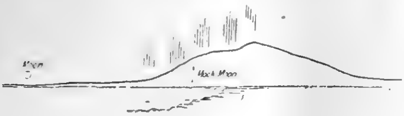

FIG. 2.

In my paper on "Atmospheric Electricity in High Latitudes" (Phil. Trans., A, vol. ccv., p. 92, 1905), I described another case of an illusion in Lapland, which made the aurora appear underneath low-lying clouds. Thus both in the north and in the south I have seen cases in which the aurora appeared to be in the lower atmosphere, and in all these cases very careful observing was necessary to discover the illusion. The mere statement, therefore, that an aurora has been seen between the observers and a near object cannot be accepted as a proof of the penetration of the aurora into the lower atmosphere. G. C. SIMPSON.

Meteorological Office, Simla, India, June 13.

ELECTRICAL phenomena resembling aurora have hitherto been observed in the laboratory only at very low atmospheric pressures, and the recent determinations of the altitude of aurora by Prof. Störmer and others have given few heights so low as 50 km. Thus reported observations of aurora below the summits of mountains are naturally viewed with suspicion by physicists. The explanations given by Dr. Simpson of the three cases he describes—the only ones apparently observed during the Scott Antarctic Expedition of 1911–12—are ingenious. But in two cases it is not explicitly stated whether the original observer accepted the proffered explanation, and in the remaining case it appears that, with Dr. Simpson's explanation before them, the majority of the observers remained of their original opinion. Sir Douglas Mawson's list included a greater number of apparent cases of aurora at low altitudes, but whether the observers possessed the exact shade of scepticism desirable in observers in such a case I am unable to say.

My own view is that we are not as yet in a position to deny the possibility of the occurrence of aurora at low levels near the magnetic poles. It is desirable that the observers of the next Arctic or Antarctic expedition should be familiar with what has been written on the subject, and that they should be specially careful in dealing with any apparently low-level aurora. Also observation of auroral heights by photography after Prof. Störmer's method should be a fundamental part of the programme of any such expedition; and while a long base should be used for some of the observations, others should employ a base sufficiently short to deal satisfactorily with heights of only a few kilometrés. C. CHREE.

August 17.

Hybrid Sunflowers.

IN crossing the different species and varieties of Helianthus some peculiar results have been obtained. The crosses referred to have all been made by my wife at Boulder, Colorado, and the results may be classified as follows:—

(1) The varieties of *Helianthus annuus* (including *H. lenticularis*, regarded by some botanists as a distinct species) when crossed together produce plants which are as fertile as the parents. In some of the mongrel varieties there is, however, a marked deficiency of pollen.

(2) The annual species of sunflowers (typical Helianthus) crossed together are quite fertile, but the hybrids are themselves nearly sterile. *H. annuus* has been crossed with three species, *H. argophyllus, H. petiolaris*, and *H. cucumerifolius*.

(3) The annual species can rarely be crossed with the perennial, and when this occurs the offspring closely resemble one or the other parent species. One such hybrid was recorded in the "Standard Cyclopedia of Horticulture" (vol. vi., 1917, p. 3281) as between *H. pumilus* and *H. annuus*. Renewed study of the living plants this year convinces me that this is an error; the perennial parent was, in fact, *H. subrhomboideus*. Both species occur here, and Mrs. Cockerell, at the time of making the cross, did not distinguish between them. Morphologically they are especially distinguished by the fact that *H. subrhomboideus* has underground migratory branches, by means of which it spreads, while *H. pumilus* is strictly stationary, reproducing only by seed. The hybrid, which closely resembles *H. subrhomboideus* (though this was the pollen parent), but is much larger, with larger broad leaves, has small or short underground branches, but, nevertheless, is stationary. That is to say, the migrators are present, but the plant does not spread by them in all directions as do the true migratory forms. Comparing the details of structure, I found that the ray-florets of the hybrid were quite without pistils, whereas these were well developed (though not functional) in the *H. subrhomboideus*. However, further investigation showed, to my surprise, that some heads of the wild *H. subrhomboideus* had the ray-florets wholly without pistils. The involu-

eral bracts of the hybrid are more distinctly pointed than those of *H. subrhomboideus*. In other cases attempts to cross annuals with perennials have resulted in total failure, as has happened when crossing *H. annuus* on *H. pumilus*, in attempts to repeat the cross described above, which was erroneously interpreted. In other cases seeds were obtained from the pollen of perennials used on annuals, and the resulting plants were indistinguishable from the annual parent. Seeds received from Mr. L. Sutton from England, representing the F_2 of a cross between the red *H. annuus* and the perennial *H. rigidus*, also gave plants entirely of the *annuus* type.

Babcock and Clausen, in their recent (1918) admirable work, "Genetics in Relation to Agriculture," have (chap. xii.) discussed those remarkable cases in which the F_2 generation of a cross gives plants resembling the original species crossed, with greater or less fertility. A very ingenious and plausible explanation is given. Collins and Kempton recently found that in crossing two distinct genera of grasses, Tripsacum and Euchlæna, they obtained plants agreeing with the pollen parent, the Euchlæna. They call this patrogenesis (*Journal of Heredity*, vol. vii., No. 3, 1916). One of the explanations offered by them is that the male nucleus may have developed in the ovary to the complete exclusion of the female, "representing in a way the counterpart of parthenogenesis." It appears quite possible that in some hybrids, and perhaps other heterozygous forms, particular pairs of homologous determiners do not both function or develop, so that *in respect to certain characters the organism is simplex*, not in the sense of the old "presence and absence theory," but in the sense of not being a hybrid at all in respect to particular features.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, August 6.

THE NITROGEN PROBLEM IN RELATION TO THE WAR.

PROF. ARTHUR A. NOYES, of the Massachusetts Institute of Technology, who is chairman of the Committee on Nitrate Investigations of the National Research Council of America —a body which owes its existence to the war—recently delivered a lecture before a joint meeting of the Washington Academy of Sciences and the Chemical Society of Washington, a report of which, under the above title, is published in the Journal of the Washington Academy of Sciences for June 19. The lecture dealt with the vital importance of an adequate supply of nitrogen compounds, particularly of nitric acid and ammonia, in connection with the war, and gave a brief description of the various efforts America was making in order to meet the demand. Nitric acid enters, directly or indirectly, into the composition of all the more important explosives, such as smokeless powder, picric acid, ordinary black powder, dynamite, trinitrotoluol, and ammonium nitrate. The last-named substance is now used on so enormous a scale that the demand for ammonia is scarcely less urgent than that for nitric acid.

The main sources of these two nitrogen compounds are: (1) Chile saltpetre; (2) by-product gas from coke-ovens; (3) atmospheric nitrogen, which is "fixed" by (*a*) the cyanamide process, (*b*) the cyanide process, (*c*) the arc process, and (*d*) the synthetic process.

For its supply of nitric acid the United States, like ourselves, has hitherto mainly depended upon imported sodium nitrate (Chile saltpetre), which is now recognised as a rather precarious source, as it depends upon adequate shipping, and is liable to be affected by enemy machinations in interfering with production, destroying plants, or blowing up the reservoirs of oil needed for fuel. Hitherto all attempts on the part of the enemy to establish a submarine base on the Pacific Coast have been foiled. But even if this source continues to be efficiently safeguarded, America realises that it is impracticable to get through imported nitrate the huge amount of nitric acid that will be needed for her Army, and that it will be necessary to supplement this supply by other means.

The demand for ammonia has led, as with us, to a complete revolution in coke-oven practice, and the old wasteful "beehive" oven is rapidly becoming a thing of the past. "By-product" ovens, in which the coal to be coked is heated in what are practically closed retorts, and the evolved gases passed through scrubbers and condensers whereby the ammonia and inflammable gases are recovered and utilised, are, under the spur of necessity, being everywhere established, to the permanent benefit of industry. The preference of the iron-smelter for the hard-coke produced in the "beehive" oven was no doubt the reason why a process of coking which wasted all the nitrogen and much of the calorific energy of the fuel has continued so long, both here and in America. The war, however, has effectually broken down what is, after all, a prejudice, and there can be little doubt that "by-product" coking will shortly become the universal practice. Indeed, it is now a question of practical politics whether, in the interests of national economy, the employment of "by-product" ovens in coking, to the exclusion of the old form, should not be made compulsory. So urgent is the demand for ammonia in connection with the war that Germany is incidentally producing far more coke than she can use immediately, either in metallurgy or as fuel, and enormous stocks are being accumulated.

As regards "fixation" processes, America is now working, to a greater or less extent, all the methods which have been developed during the past fifteen years. Even before the war the American Cyanamid Co. at Niagara Falls was producing about 20,000 tons of cyanamide a year, largely for use in agriculture. By the action of steam upon this substance it is practicable to get substantially all the original nitrogen in the form of ammonia. This process is capable of a great extension, and has already reached considerable proportions in Germany, where it competes with the Haber process. The American Government is building a cyanamide plant with a capacity of 110,000 tons of ammonium nitrate at Muscle Shoals, Alabama, and a third plant has been authorised for the production of another 110,000 tons in Ohio. The cyanamide process has the advantage that it can be installed in many places in the country, and that it requires little power. It has probably a great future before it—certainly immediately—but whether it is ultimately destined to be supplanted by the synthetic process time alone can show.

The cyanide method is still in process of development, and is carried out in various ways. Several concerns are working it, among them the Nitrogen Products Co. at Saltville, Virginia, and the Air Reduction Co., and the Government is also building a plant. The product first formed is sodium cyanide, which, as in the case of cyanamide, can be made to yield ammonia under the action of steam. Sodium cyanide is, however, so valuable as a metallurgical adjunct that it will not pay to convert it into ammonia until the market for cyanide has been satisfied.

The synthetic process was already worked in America by the General Chemical Co. before the outbreak of war, and it had so far perfected the process—well beyond the point which the Germans had reached—that it was able to operate at lower temperatures and pressures. The Government has taken over the process of the company, and is now working it at Sheffield, Alabama, with a plant capable of producing 20,000 tons of ammonium nitrate per annum. A portion of the ammonia produced is put through the oxidation process, converting it into nitric acid, which is combined with more ammonia to form ammonium nitrate.

The arc process is especially suitable for the production of nitric acid. The reactions involved are chemically very simple, but they need a large amount of energy, which, under American conditions, would be very expensive to produce. By recent agreements with the Norwegian Government the United States and the Allies will receive about 112,000 metric tons of calcium nitrate per annum, made by the arc process, as against the limit of 8000 tons sent to Germany. As matters stand it is very unlikely that the arc process will obtain any very extensive application in America.

Prof. Noyes concludes his lecture with some remarks upon the relative economies of the different processes, but the conditions at present are so abnormal that it is impossible to make any very definite statements as to their ultimate commercial prospects. In the meantime the Government is using all its resources, expanding its imports of Chile saltpetre, introducing as rapidly as possible "by-product" coke-ovens, and developing new fixation processes through the Nitrate Division of the Ordnance Department with the co-operation of the Bureau of Mines.

The oxidation process of turning ammonia into nitric acid has been so far perfected that a conversion of from 92 to 95 per cent. is now possible, and the process of absorption of the nitric vapours has been much simplified. It is certain that, as one result of the war, there will be a very marked development in the States within the next year or two of American processes of nitrogen fixation.

INDIGO IN BIHAR.

AN account of the recent history and present position of indigo in Bihar, by Mr. W. A. Davis, indigo research chemist to the Government of India, was reviewed in NATURE of July 18 last. In two further communications Mr. Davis has discussed the future cultural prospects of the industry,[1] outlined the difficulties to be surmounted if success is to be attained, and detailed the conclusions indicated by a study of Bihar indigo-soils.[2]

Among the various factors—careful seed-selection, improved cultivation, better manufacture, and sounder business organisation—on which the fate of natural indigo depends, the most urgent is the cultural. The evidence presented indicates that the indigo-soils of Bihar have been steadily losing fertility through exhaustion of their available phosphate. This conclusion is based on the results of actual soil-analyses, the success with indigo grown outside Bihar in soils still containing adequate available phosphate, and the response of indigo within Bihar to the manurial use of superphosphate.

The treatment appropriate for *Indigofera sumatrana,* until 1898 the indigo exclusively grown in Bihar, does not suit *I. arrecta,* introduced in 1899. After this difficulty was overcome the results with *I. arrecta* appeared to justify the hope that extended cultivation of this new plant might save the natural indigo industry. The product of *I. sumatrana* may no longer be expected to compete successfully against artificial indigo. But actual results, secured in 1906–7, indicate that natural indigo from *I. arrecta* may be manufactured and profitably sold at rates "cutting" the lowest pre-war quotations for synthetic.

The disappointment of this hope is popularly attributed to two blights—*psylla* and "wilt." The entomological malady can scarcely be accounted serious. There is no evidence that *psylla* injures indigo of normal vigour; there is evidence that affected plants which regain thrift may "grow through" and "shake off" *psylla* attack. The "wilt" is not induced by any pathogenic organism; it is the sequel to defective nutrition, explicable by the phosphate-exhaustion now characteristic of Bihar soils.

The remedy then for Bihar is to employ superphosphate. Even so, the only hope for the future lies in the cultivation of *I. arrecta;* that of *I. sumatrana* is contra-indicated on economic grounds. Seed-selection to secure strains of *I. arrecta* rich in indican is also a pressing need. There is doubtless another possibility. Outside Bihar, under climatic conditions hitherto deemed unsuitable for indigo, *I. arrecta* thrives well. It may in time prove more economic to transfer indigo from Bihar to localities with soils sufficiently rich in available phosphate than to transport phosphate to indigo in Bihar.

What lies outside debate is that, if the natural

[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., part iii. (July, 1918).

[2] "A Study of the Indigo Soils of Bihar." By W. A. Davis. Agricultural Research Institute, Pusa, Indigo Publication No. 1 (1918).

indigo industry is to survive, *I. arrecta* must receive the phosphate it needs. So far as the cultural factor is concerned the future depends upon the indigo grower. Unless he is prepared to supply his plant with the food requisite for its vigorous thrift, and to do this without further demur and delay, the end of the war must mean the end of natural indigo, not in Bihar alone, but throughout India.

NOTES.

WE regret to learn that the Natural History Museum is losing the services of Mr. W. R. Ogilvie-Grant, assistant keeper of the department of zoology and head of the Bird Room, who has been compelled to relinquish his appointment owing to continued ill-health. Mr. Grant has served in the museum for thirty-six years, having entered the department as an assistant in the year 1882. He is the author of the official catalogue of the game-birds, and joint author with the late Dr. R. Bowdler Sharpe of two other volumes of the great British Museum Catalogue of Birds. Mr. Grant was for many years editor of the Bulletin of the British Ornithologists' Club, and he carries with him in his retirement from official harness the good wishes and esteem of his many friends and brother ornithologists.

WE learn from the Journal of the Washington Academy of Sciences that Dr. Cleveland Abbe, meteorologist of the U.S. Weather Bureau, and editor of the *Monthly Weather Review*, has been removed from his positions, the reason given being his "long-standing and generally well-known friendly sympathies for the Imperial German Government." It is stated that Dr. Abbe has denied disloyalty, and asked to be given an opportunity to reply to any charges presented.

PROF. C. A. PEKELHARING has retired from the chair of physiological chemistry in the University of Utrecht, and has been succeeded by Dr. W. E. Ringer, one of his former assistants, and originally an inorganic chemist.

ACCORDING to the *Nieuwe Courant* of August 24, Prof. Haeckel's house at Jena, Villa Medusa, will be transformed into a Haeckel museum and presented to the University. It will contain Haeckel's extensive collections, and be combined with an institute for general developmental theory. The Carl Zeiss foundation is giving financial aid.

THE *Times* announces that Mr. V. Stefansson, the leader of the Canadian Arctic Expedition, has arrived at Dawson on his way to Ottawa. Mr. Stefansson's expedition left Esquimault in the summer of 1913 to explore the Beaufort Sea and adjacent islands of the Canadian Arctic Archipelago. It will be remembered that his chief vessel, the *Karluk*, was crushed in the ice in January, 1914. Three members of the expedition lost their lives on that occasion, Dr. Forbes Mackay, Mr. James Murray, and M. Henri Beuchat. Mr. Stefansson, with several members of his staff, was ashore at the time the *Karluk* broke adrift, and he continued the work of the expedition. The southern party, under the leadership of Mr. R. M. Anderson, returned in the autumn of 1916 after doing a considerable amount of work in the Mackenzie delta and the coast of the mainland to the east. Mr. Stefansson himself discovered new land north of Prince Patrick Island in June, 1915, and further land north-west of Banks Land in 1916. No news of his discoveries since that date has yet been announced, but Mr. Stefansson has probably been engaged in extending his explorations, in surveying his discoveries, and in studying the Eskimo. He announces that he intends to return to the Arctic in a year's time. There has been no news of Mr. Storkersen, a member of the expedition, who, with three Eskimo, left Herschell Island last winter in an attempt to reach Melville Island across the sea-ice, since April last, when he sent back word that he had gained a point 175 miles north of the Alaskan coast.

WE regret to record the death of Lord Forrest, which occurred at sea last week on his voyage from Australia to England. Lord Forrest, better known as Sir John Forrest, was born in Australia of Scottish parents in 1847. He entered the Survey Department of Western Australia in 1865. In 1869 he undertook to search for traces of the German explorer Leichhardt. Though he failed in the main object of his expedition, Forrest made many discoveries. In 1870 he explored the south coast of Australia from Perth to Adelaide, and in 1874 he accomplished a journey through the heart of Western Australia. Starting from Champion Bay, he struck north-east to the Murchison River, which he followed to the Robinson Ranges, and then went along the 26th parallel to Peake Station on the overland telegraph, where he turned south and reached Adelaide. This remarkable journey of about 2000 miles was accomplished in five months, and proved that the interior of the colony was useless for settlement. In succeeding years Forrest surveyed the country between Ashburton and Lady Grey Rivers, and the Fitzroy district. From 1883 to 1890 he was Surveyor-General of Western Australia, and in 1890 became Premier. In 1901 he joined the Commonwealth Government, and served successively in several capacities. He had been a ceaseless advocate of a transcontinental railway, and regarded the completion of the line from Perth to Adelaide as the triumph of his political career. Lord Forrest was a gold medallist of the Royal Geographical Society and an LL.D. of Cambridge, Adelaide, and Perth.

BY the death of Sir Ratan Tata, which occurred on September 5, at the age of forty-seven, a notable figure in the industrial and philanthropic life of India and England has disappeared. The son of Mr. Jamsetjee N. Tata, the well-known Parsi capitalist of Bombay, he married the daughter of Ardesir Merwanji Seth, the head of the priestly community of the Bombay Parsis. Mr. Jamsetjee N. Tata, who died in 1904, had planned various industrial enterprises, which he left to his sons, Sir Dorab Tata and Sir Ratan Tata, to bring to completion. One of these schemes was the establishment at Mysore of the Indian Institute of Research for the promotion of scientific, medical, and philosophical studies. His sons carried out his intentions, and provided a liberal endowment for the institute. Sir Ratan Tata's fame rests on his development of the Indian steel and iron works, for which the preliminary investigations were made at his expense by a staff of European and American experts. He and his brother, Sir Dorab Tata, carried out this enterprise, and founded the great metal works at Sakchi, the capital of which amounts to some millions sterling. Another scheme due to the brothers was to store and utilise the heavy rainfall of the Western Ghats for the supply of cheap and abundant electrical energy at Bombay, a work which has few parallels in other parts of the world. Sir Ratan Tata had long resided at York House, Twickenham, and at Versailles. In London he was deeply interested in scientific and philanthropic projects. He founded the Ratan Tata Department of

Social Science and Administration in the London School of Economics, and he established a fund of 1400*l.* per annum for the study of means to prevent and relieve destitution. He supported the Indian Moderate Party's programme of political reform in India, and received the honour of knighthood in 1916. It is fortunate that Sir Ratan's industrial enterprises are now under the competent supervision of his brother, Sir Dorab Tata.

THE death is announced, at the age of sixty years, of Dr. J. Harper Long, professor of chemistry at the North-Western University Medical School, Chicago, and a former president of the American Chemical Society.

THE recent death of Mr. W. Francis de Vismes Kane, of Drumreaske, Monaghan, Ireland, at the age of seventy-eight, is announced in the *Irish Naturalist* for July. Mr. Kane was well known to entomologists through his "Handbook of European Butterflies" (1885) and his "Catalogue of the Lepidoptera of Ireland" (1901), but his scientific interests were wide, as he attained distinction also as a student of the freshwater Entomostraca and of prehistoric archæology.

NEWS has just been received that Lieut. L. J. F. Oertling, who was reported missing on August 8, died on that date from wounds received in action. Lieut. Oertling was in the twenty-seventh year of his age, and was educated at Clifton College, afterwards entering the business of his father, Mr. Henry Oertling, the well-known manufacturer of chemical and other types of balances. He joined the Inns of Courts O.T.C. shortly after the outbreak of war, and obtained a commission in the Bedfordshire Regiment (T.), proceeding to France with the 8th Battalion. Eventually he became attached to the Royal Flying Corps.

PROF. FRASER HARRIS has now completed the history of the medical aspect of the great disaster at Halifax, N.S., on December 6, 1917. It is expected that the history and its appendices will be published under the auspices of the Halifax Relief Commission, a body appointed by the Canadian Government to take over the care of all matters arising out of the disaster.

THE Faraday Society has again arranged for a series of general discussions of important scientific subjects during the coming session. On November 4 the subject of discussion will be the occlusion of gases by metals; and that at the December meeting will be the present position of the electrolytic dissociation theory. After the New Year, discussions will be held on catalysis, the theory of flotation processes, and the scientific use of fuel. All these subjects are of wide interest on both the industrial and the scientific sides, and their discussion by competent authorities should have a stimulating influence upon their development. Communications are invited from investigators who have devoted particular attention to any of the subjects in the programme. The address of the society is 82 Victoria Street, S.W.1.

THE sixth annual meeting of the Indian Science Congress will be held in Bombay from January 13 to 18 next, under the patronage of Lord Willingdon, the Governor of Bombay, and the presidency of Sir Leonard Rogers, F.R.S. The sections and their presidents will be:—Applied Botany and Agriculture, the Hon. G. F. Keatinge; Physics and Mathematics, Dr. D. N. Mallik; Chemistry, Mr. F. L. Usher; Systematic Botany, Mr. S. R. Kashyap; Zoology, Mr. S. W. Kemp; Geology, Dr. L. L. Fermor; and Medical Research, Lt.-Col. Glen Liston. Further particulars of the meeting may be obtained from the hon. secretary, Dr. J. L. Simonsen, Indian Munitions Board, Simla.

AN editorial article in the *Geographical Journal* for September (vol. lii., No. 3) discusses some important points in the nomenclature of Himalayan peaks. It is the practice of the Survey of India to veto all names and employ only numbers to designate peaks. Mount Everest is the only exception. Even Godwin-Austen is not allowed in place of K^2 or its modern synonym Pk. 13/52A. Most of the peaks have no native names, and the difficulty in giving names seems to lie in finding ones that will harmonise with such as exist. The Survey of India rightly objects to trivial names which are out of keeping with the ranges as a whole. Cathedral Peak, Broad Peak, and so forth may be appropriate locally, but are unsuitable continentally, and in any case are not specific. The numbering of peaks on the system now adopted has the merit of indicating the degree-sheet on which the peak occurs. In the example cited above, 52A is the number of the degree-sheet and 13 the number of the peak. On the other hand, the system has obvious defects, the greatest, perhaps, being that numbers are difficult to remember, and give anonymity to the peaks. Mr. Hinks suggests eight figure-numbers giving latitude and longitude. That would involve greater precision, if a severer test of the memory, but introduces complications where two peaks lie close together and seconds have to be added. No doubt in time many of these peaks will receive names, despite official disapproval.

IN the July issue of the Journal of the Land Agents' Society there appears an article on "Wild Birds and Legislation," by Dr. W. E. Collinge. Although there will not be general agreement with the author in his conclusions that the question of wild-bird protection has never received really serious consideration, that the majority of the Wild Birds' Protection Acts have been ill-considered, and that no attempt has been made by those who advocate the protection of wild birds to understand the problems presented by wild-life, yet we thoroughly endorse his opinion that there is immediate need for a new and comprehensive Act—one that would afford protection to rare and vanishing species as well as to those birds which are beneficial, and would at the same time allow for the taking of adequate repressive measures against those species which are destructive and have become too numerous. As a matter of fact, a Departmental Committee was appointed by the Home Secretary in 1913 to consider what amendment in the law relating to wild birds and its administration might be required. This Committee held a number of meetings at which such questions as those raised by Dr. Collinge were freely discussed and considered, and many witnesses, representing all parties interested, were examined. The war, unfortunately, put a stop to the deliberations of the Committee, but it is to be hoped that when the Committee next meets it will be able to suggest lines on which a new Wild Birds' Protection Act, applicable to the whole of the British Isles, should be framed to replace the Act at present in force, with its perplexing supplementary Acts and the local Orders issued under them. The economic status of birds is now fully recognised, and it is high time that there should be created an Ornithological Bureau, similar in function to that long since established in the United States of America. To such a bureau should be referred all matters in connection with the administration of the Wild Birds' Protection Act, and the consideration of such modifications as may be necessary to meet special and local conditions.

THE American Museum of Natural History (New York) has just issued, as the first article of vol. xxxix. of its Bulletin, "A Revision of the Vespidæ of the Belgian Congo," by J. Bequaert. This is a systematic paper of more than usual importance, the generic and specific diagnoses being exceptionally detailed and carefully illustrated by structural drawings and coloured plates, and the classificatory facts being illuminated by many notes on behaviour and by valuable geographical discussions, with many distributional maps. It is pleasant to read in the author's introduction that when conditions in Europe deprived him of the fruits of all but a small part of his own collecting, he found ample materials for study in "the splendid collections of the American Museum Congo Expedition," as well as a hearty welcome and cordial assistance from the naturalists of the United States. From the same institution has been issued as a "Guide Leaflet" (No. 48) a popular pamphlet by C. E. A. Winslow and F. E. Lutz on "Insects and Disease." The facts and methods of germ-transmission by insects are clearly set forth, and illustrated by good photographs of specimens and models exhibited in the American Museum.

IN the latest part of the *Science Reports* of the Tohôku Imperial University, Japan (Second Series, Geology, vol. iii., No. ii., 1918), Prof. H. Matsumoto has several interesting notes on the fossil mammals of Japan. A new molar tooth of an elephant from Kaza seems to be exactly intermediate between the molars of Elephas and Stegodon. Part of the lower jaw of an ancestral deer, probably of Lower Miocene age, is referred to a new species of Amphitragulus, and is unusually large. An elaborate study of some skulls and frontlets of bison from the Pleistocene of Japan shows that they belong to the extinct species *Bison occidentalis* and *B. crassicornis*, which are already known from North America (chiefly Alaska) and Siberia. A discussion of the skull and teeth of the remarkable Miocene sirenian Desmostylus is especially valuable. Good specimens have now been obtained both from the Pacific coast of North America and from Japan, so that instructive comparisons can be made. The Japanese species is the largest sirenian known, with a skull 90 cm. in length. It seems to have frequented estuaries rather than open seas, and its peculiar front teeth were probably used like those of a hippopotamus to dig up nutritious plants from mud. The molars are especially effective grinding teeth, and are sufficiently deepened to last during a long life.

PROF. CHAS. CHILTON, who described the first species of Phreatoicus in 1883, has added an interesting chapter to the history of this crustacean genus by giving a description (Journ. Proc. Roy. Soc. N.S. Wales, vol. li., pp. 365–88, 1918) of a fossil species based on ten impressions found in the Wianamatta Shale (probably Upper Trias) of Queensland. Although none of the specimens are complete, the head and the first peræopods not being clearly represented in any of them, the evidence afforded by the remainder of the animal, which is in a good state of preservation, leaves no doubt as to the correctness of the identification. The fossil species, described as new under the name *Phreatoicus wianamattensis*, was similar in general appearance to *P. australis*, and reached a length of 30 mm. The living members of the Phreatoicidea, a primitive group of the Isopoda, are found in the fresh waters of Australia, Tasmania, New Zealand, and South Africa.

THE Geological Survey of Hungary has published the first volume of a new serial named *Geologica Hungarica*. It is a handsome quarto of 450 pages in the Magyar language, and is well illustrated by 275 text-figures and 26 plates of fossils. It comprises three parts, dealing respectively with Oligocene Mollusca, Tertiary Echinoids, and Callovian Ammonites. The last part is by the director of the survey, Dr. L. Loczy, and concludes with a valuable stratigraphical table showing the various Hungarian equivalents of the Lower and Middle Oolites of western Europe.

THE past summer has, for the most part, been agreeable and pleasant from a meteorological point of view, although the totals and averages of the several elements, and of the rainfall especially, have been liable to mislead and to give a somewhat unsatisfactory impression. Some of the meteorological happenings were abnormal, but they have, on the whole, proved to be an advantage. Combined records for the three months, June, July, and August, show a general deficiency of rain except in the north of Scotland and in the south-east of England. In the neighbourhood of London the aggregate rainfall for the three months was about 9 in., which is nearly 2·5 in. more than the normal, although about 2 in. less than in 1917, and it has only been exceeded in one other summer, 1903, since 1890, in twenty-eight years. June had a decided deficiency of rain over the British Isles, and chiefly so in England, where it was mostly less than 50 per cent. of the average, but July was excessively wet, yielding generally over the kingdom an excess of nearly 50 per cent. of the average, whilst August has yielded a total far below the normal. In July thunderstorms were phenomenal over England, and at Kew Observatory they occurred on nine days, being more frequent than in any July since 1880. In London the mean temperature for the summer was 61·5°, the mean maximum reading being 10° higher and the mean minimum 10° lower than the mean temperature, these results being not very different from the average, but, on the whole, there has been an absence of hot days. Sharp ground-frosts occurred in many parts of England, especially in the eastern, central, and south-eastern districts, on several occasions in June, and their effects are distinctly traceable. Over the country generally there has been during the summer a slight deficiency of temperature. The sunshine has not differed very materially from the average.

THE *Cairo Scientific Journal* (vol. ix., No. 100, January to March, 1917) contains an account by the late Prof. Kr. Birkeland of simultaneous observations of the zodiacal light by himself and an assistant, the one at Helwan in Egypt, the other at Salisbury in Southern Rhodesia. The stations possessed the same longitude, 31° E. of Greenwich, while differing nearly 48° in latitude. The observations discussed were made on sixteen occasions between July 8 and September 2, 1915, but the results are treated as preliminary, the hope being expressed of repeating them at more suitable stations at a more favourable season, adopting an improved photographic method. The observational results are shown in a number of figures, and it is claimed that they show two definite results—first, that the height of the visible light column was much greater at Salisbury than at Helwan, and, secondly, that there was a considerable relative displacement of the light columns, to the north at Helwan, to the south at Salisbury. There are numerous references to Prof. Birkeland's theoretical views, which associate the zodiacal light with the earth's magnetism. He apparently believed in the existence of "a *principal* ray system, a lenticular nebula round the sun which scatters the sunlight, and of a *secondary* scattering ray system round the earth, captured from the principal solar system by the earth's magnetism." In Prof. Birkeland's view, "a nebulous ring round the earth will *alone* never give any satisfactory explanation of the zodiacal light."

THE water supply to the town of Hobart, Tasmania, was the subject of an article in the *Engineer* of September 6. The reservoir has a capacity of 207 million gallons, and the dam is an interesting instance of two gravity wings with an intervening arch section. The wings are $293\frac{1}{2}$ ft. and $203\frac{1}{2}$ ft. long respectively, in straight lengths, and the arch is $232\frac{3}{4}$ ft. long, with a radius of 200 ft. The wings and the arch are not actually connected; a 6 in. by 6 in. bitumen joint, with sheet-lead faces, forms a watertight key from ground-level to the top of the dam. The maximum depth from the summit of the arch section in the centre to the foundation is 201 ft. The greatest depth of water in the reservoir is 95 ft., and the surface-level is 905 ft. above sea-level. The dam is constructed of concrete, and the arched portion is reinforced with iron rails, both vertically and horizontally. The thickness of the arch at the top is 6 ft., and at the bottom 54 ft. An unforeseen fissure in the foundation necessitated the sinking of a shaft to a depth of 185 ft. below the ground-level; this was refilled with concrete.

L'Aérophile for May gives a description of the Vincent multiplex compass, which, it is claimed, combines in one small case all instruments required by the aviator, the navigator, and the explorer for the determination of magnetic declination and for the solution of astronomical, geodetic, and topographical problems required for determining position and directing the course of travel. It is also claimed that this compass provides a means of steering craft overseas with a precision hitherto unknown. The compass is provided with a reference line or directrix, which may be rotated, a movable index card with sights for the measurement of angles and azimuths, and a style for the solution of time problems. The whole compass is suspended on gimbals inside a box, which is pivoted on a slab. The box carries on one of its faces a needle and a dial, and on its bottom a second needle, which moves over degree graduations on the slab. The method of using the compass is explained.

A FRENCH Electrotechnical Commission has just published, in English and French, the results of an investigation on aluminium. The mechanical and physical tests give the density, coefficient of expansion, breaking stress, and elongation. Chemical analyses were also made. According to the *Revue Générale de l'Electricité* for June 8, the electrical measurements were made at the *Laboratoire central d'Electricité*, and include resistivity and temperature-coefficient of commercial aluminium. A table is given in which the constants for three different samples of aluminium, containing slightly different amounts of impurities, are set out.

DR. P. LINDNER, of Charlottenburg, has taken out a German patent (*Chemiker-Zeitung*, June 29) for obtaining fat from low forms of animal life. By populating suitable waste material with these minute forms he obtains material from which fat may be extracted. As examples he mentions decaying mushrooms and non-edible fungi, putrefying meat, gutter refuse, etc., grass and spoilt hay, masses of dead leaves infested with plant-lice, and stale yeast. Dr. Lindner further states that certain materials may be inoculated with the germs of bacteria or micro-fungi and cultivated. The mass of prepared material is triturated and mixed with water, then heated, and the fat skimmed off; or it may be recovered chemically by treating the triturated mass with a solvent.

WE learn from a note in the Journal of the Society of Chemical Industry for August 15 that the giant kelp of the Pacific Coast is now being utilised on a very large scale for the production of both potash and acetone. The works, which are situated at Potash, near San Diego, California, cover thirty acres of ground and give employment to 1000 men. Acetone, rather than potassium compounds, has become the chief product; it is required for the British authorities, and is of excellent quality. Among the subsidiary products recovered are ethyl propionate and ethyl butyrate, which are now being obtained on a scale never before approached. These compounds serve as solvents, and are especially valuable just now as substitutes for amyl acetate, on account of the necessity for conserving acetates. The quantity of kelp cut last year was about 24,000 tons a month.

THE Cambridge Scientific Instrument Co., Ltd., has issued a new list (No. 137) dealing with the Cambridge microscope lathe-attachment. This is a device recently placed on the market to aid in tool-setting for the production of exact and interchangeable screw-threads. The attachment consists of a compound microscope fitted with an eyepiece that is capable of being focussed on a diaphragm ruled with two fine lines representing the thread-angle of the tool to be used, and with a third line equally inclined to them. When the third line is set parallel to the axis of the cylinder to be threaded, the two intersecting lines represent accurately the position in which the tool must be set. The device is rigidly fixed to the slide-rest, consequently both move together. The standard diaphragm is engraved with a 55° angle. The inaccuracy of tool-setting by this method should not exceed $0^\circ\ 3'$. The list describes also the Cambridge alignment tester for ensuring the correct alignment of machine-tool beds within close limits. In this instrument a microscope fitted with a micrometer eyepiece is used to view a fine wire stretched along the length of the bed. One division of the micrometer scale corresponds with $1/2000''$, so that high accuracy is obtainable.

AN outstanding feature of Catalogue No. 175 just issued by Messrs. W. Heffer and Sons, Ltd., Cambridge, is a number of books printed at special presses such as the Kelmscott, Doves, Riccardi, and others. Sections appealing more particularly to readers of a journal such as NATURE are devoted to agriculture, botany, geology, mathematics, physics and chemistry, zoology and biology, physiology, anatomy, and medicine.

THE following works are in the press for publication by the Carnegie Institution of Washington:—"Human Vitality and Efficiency under Prolonged Restricted Diet," by Benedict, Miles, Roth, and Smith; "A Biometric Study of Basal Metabolism in Men, Women, and Children," by J. A. Harris and F. G. Benedict; "Effect of Alcohol on Psycho-physiological Functions," by W. R. Miles.

MESSRS. CHARLES GRIFFIN AND CO., LTD., will publish shortly "A Treatise on British Mineral Oil," by E. H. Cunningham Craig, A. G. V. Berry, Dr. A. E. Dunstan, Dr. Mollwo Perkin, and A. Campbell. The work will contain a foreword by Sir Boverton Redwood, Bart., and be edited by J. A. Green.

THE article by Dr. James Ward on "Psychology" in the "Encyclopædia Britannica" has been expanded by the author, and will be published shortly in book form by the Cambridge University Press.

OUR ASTRONOMICAL COLUMN.

THE HARVEST MOON.—The September full moon occurs this year on the 20th at 1.1 p.m. G.M.T., but, although this is so near the autumnal equinox, the daily retardation of the time of rising about full moon is not the smallest possible on account of the unfavourable position of the moon's node. The following are the *Greenwich mean times* of rising, southing, and setting from September 13 to September 28:—

Rises		Souths		Sets	
	P.M.		P.M.		P.M.
Sept. 13,	1.58	Sept. 13,	5.55	Sept. 13,	9.54
14,	2.46	14,	6.48	14,	10.56
					A.M.
15,	3.25	15,	7.42	16,	0. 6
16,	3.58	16,	8.36	17,	1.23
17,	4.26	17,	9.29	18,	2.44
18,	4.51	18,	10.22	19,	4. 8
19,	5.14	19,	11.16	20,	5.34
			A.M.		
20,	5.37	21,	0.10	21,	7. 1
21,	6. 1	22,	1. 6	22,	8.28
22,	6.30	23,	2. 3	23,	9.53
23,	7. 4	24,	3. 2	24,	11.13
					P.M.
24,	7.46	25,	4. 1	25,	0.23
25,	8.37	26,	5. 0	26,	1.22
26,	9.37	27,	5.56	27,	2. 8
27,	10.43	28,	6.49	28,	2.44
28,	11.52	29,	7.39	29,	3.13

THE NEW STAR IN AQUILA.—A preliminary account of some valuable photographs of the spectrum of Nova Aquilæ obtained during June at the Dominion Observatory, Ottawa, has been given by Dr. W. E. Harper (Journ. Roy. Ast. Soc. Canada, vol. xii., p. 268). The photographs of June 9 are of special importance as showing that the absorption bands which preceded the appearance of bright lines were already strongly displaced to the violet sides of their normal positions, the displacements corresponding with 1250 km. per sec. if interpreted in terms of motion. Emission bands on the red sides of these absorption bands were first recorded, as elsewhere, on June 10. On June 10, 13, 14, and 15 the absorption bands accompanying the bright bands of hydrogen were double, the displacements of the two components representing velocities of 1350 and 2200 km. on June 10, and 1700 and 2300 km. on June 15. From June 17 to June 23 only the less refrangible components of the absorption bands were present, and the velocity indicated was 1750 km. per sec. Sharp H and K lines appeared on all the plates, and these maintained the same positions throughout, their displacements representing a velocity of 22 km. per sec. towards the solar system.

From a circular issued by the Government Astronomer, it appears that the new star was independently detected in New Zealand by Mr. A. G. Crust at G.M.T. June 8d. 21h. 40m., and by Mr. G. V. Hudson at G.M.T. June 8d. 23h. 15m.

The nova is still visible to the naked eye, the magnitude being about 5, with small oscillations. The nebular characteristics of the spectrum are strongly marked.

WOLF'S COMET.—Mr. Jonckheere observed this comet on September 2 with the 28-in. at Greenwich. At midnight it preceded the star BD+22° 3918 by 1m. 33·67s., and was 25·6″ south of it. The magnitude was estimated as 12·8, and the diameter was 30″. Mr. Harold Thomson observed it on August 31 with his 9-in. reflector at Newcastle. He estimated the magnitude as 12, and stated that there was a central condensation of light, but no stellar nucleus. The position agrees closely with Kamensky's ephemeris.

NEW SCIENTIFIC FACTORS IN INDUSTRY.

ONE of the impressions of the British Scientific Products Exhibition that remain in the memory is the silent revolution that many departments of industry have undergone since the war began by processes which could only result from scientific research. Among the processes which have thus been affected, mention may be made of the welding of aluminium, copper, and other non-ferrous metals by oxy-acetylene—branches in which German workers were pre-eminent before the war. Mr. C. R. Darling has shown that continuous research in this direction has resulted in great improvements being effected. "Thermit" processes, formerly under German control, have now passed into British hands, and most of the compositions used are now made in this country, patient investigation having overcome the difficulties involved. A great advance has been made in the art of electric-arc welding, which is now used in the production of "rivetless" ships. This process was in its infancy at the outbreak of war, and at that time was more highly developed in Germany than in other countries. The excellent progress made has been due to the enterprise of the firms which have specialised in this work, and systematic researches are in hand with the view of finding methods for producing the most satisfactory welds at the minimum of cost. Arc-welding is capable of application to non-ferrous metals, and is destined to play an increasingly important part in the future.

The production of high-class steel by the electric furnace has been developed extensively during the past four years. In 1913 the number of electric steel furnaces in Europe and America was 114; to-day there are probably as many in England alone. Mr. Darling suggested that in the event of a large super-power station for the production of cheap electricity being erected near London, it is quite possible that the metropolis may become an important steel-refining centre. The spraying of metals on to cold surfaces by the Schoop process has so far not met with extended application, but it has been suggested that concrete ships might be coated with metal in this manner, so as to prevent the destructive action of sea-water. In the production of materials by the electric furnace, Mr. Darling reminded us that Britain has always been backward, and remains so. Cheap electrical power is needed for the success of this branch of industry, and up to the present these substances have been produced at the hydro-electric installations at Niagara, in Norway, and elsewhere. Calcium carbide is now made in considerable quantities at Manchester, but the cost is far greater than in the case of Norway, owing to the difference in the cost of power. On the other hand, it is now possible to obtain electric power as cheaply on the Tyne as at Niagara, and there appears to be no good reason why carborundum and alundum, now universally used as abrasives, should not be made in this country. The same applies to artificial graphite and other products now extensively manufactured at Niagara.

In the future, furnace products are bound to increase in importance; in particular, refractories urgently needed for electric steel smelting may be expected to be forthcoming, and it is a matter for regret that this branch of high-temperature work has been neglected in Britain. Facilities for research on electric-furnace products on a reasonably large scale are non-existent, and it is urgently important that this defect should be remedied at once. An exception to the general neglect of electric-furnace products mentioned by Mr. Darling is provided by vitreous silica, a material discovered in this country and now forming the basis of a considerable industry, which has attained its present dimensions as the result of continuous research and commercial enterprise. No field of investigation offers greater promise of useful discoveries than that of high temperatures, and vitreous silica may be taken as an example of what might be achieved in many directions if systematic work were carried out.

Dr. Walter Rosenhain, in his lecture at King's College, urged the need for serious attention to aluminium and its alloys. Even now, for aircraft and other military purposes, this subject has the importance of a "key" industry; but considerable development in the wider industrial field may be expected. Dr. Rosenhain claims that, so far as scientific research is concerned, we hold a very high place in regard to light alloys. What is needed now is industrial enterprise which will give commercial application to the results obtained. Cases were mentioned of structural design where the greater efficiency of the lighter material would make it easy, or, at least, possible, to carry out work which could not be contemplated with ordinary steel. Even where there is no approach to a limiting span, there are many cases where the use of a lighter metal would effect very great economy. A direction in which the use of strong and light materials is of very great importance is in the construction of objects which have to be started and stopped. The greatest expenditure of power in many cases occurs in this process of starting and stopping owing to the fact that energy has to be put into the moving objects while they are being set in motion, and has to be absorbed again—and usually wasted—when they have to be stopped. The reciprocating parts of machinery are examples of that kind, and the importance of making these as light as possible has been fully recognised recently. Tube and electric railways generally furnish other impressive examples. To start an electric train and to bring about that rapid acceleration which is the most valuable feature of electric railways, an enormous expenditure of power is necessary. In one actual case the starting current for a train is as high as 3000 amperes at 500 volts. As this same amount of power has to be absorbed when a train is stopped, it is taken up by the brakes and affects the cost of running by heavy wear of rails and tyres. The power required for these operations is simply proportional to the weight of the train. Dr. Rosenhain suggested that if the steel parts of the train, the under-frames of the carriages, and much of the electric locomotives were constructed of light alloy, a very considerable saving of weight would result.

The main reason why light alloys have not come into much wider use is probably due to their cost, which is still very high as compared with that of steel, while there are also certain technical difficulties. Systematic research, however, has now gone far enough to clear the ground and to place aluminium alloys on a secure and sound basis. With regard to cost, although aluminium alloys cannot as yet be regarded as competing with steel, Dr. Rosenhain does not believe that the difference will persist. He looks forward to a cheapening in the cost of aluminium by the development of economical means of separating the aluminium, which is present in considerable proportions in all clays and in many rocks, also in the exploitation and method of utilisation of water-power for this purpose. There lies in this direction a great field for future progress provided that the requisite scientific research and industrial enterprise are applied to it.

Mr. C. H. Wordingham indicated many of the fields in which there was scope for electrical engineering. A new and extraordinary application is to the propulsion of battleships and cruisers, while a most important field has been opened up in connection with salvage work in respect of an electric motor driving a pump which will work wholly immersed in the sea. These and other developments can only take place, however, by a cheap supply of power, and Mr. Wordingham advocated a scheme for the establishment of large or super-power stations. Among the important industries established in this country which are dependent upon the cheap supply of power, Mr. Wordingham mentioned carbons for searchlights and other arc lamps, magnetos, incandescent lamps, and insulating materials. One very important class of insulating materials almost wholly imported from abroad is that known under the generic term of composite materials. These materials are usually mouldable, and are used largely for a great variety of apparatus. One particular class of vulcanised material is a vital part of the magneto used in connection with the ignition and internal-combustion engines.

A curious fact mentioned by Mr. D. T. Chadwick in a paper on the industrial development of India during the war is that, in spite of a forest area of more than 250,000 square miles, imports of timber into India exceed exports by some 250,000 tons a year. These imports consist largely of teak, hard woods, and pine. In some cases wood is imported from Siam when exactly the same was available locally and at a lower price. The development which has taken place since the war is due to the realisation of the vital necessity of utilising local resources, and by the adoption of scientific methods in this process. Inquiries are being carried out in co-operation with business houses in directions in which forest resources are essential to industries. In regard to sandalwood oil, a trade has been established which was formerly centred in Germany; before the war sandalwood to the value of more than 100,000*l.* was exported annually. The factories established in Mysore since the war are now capable of producing nearly 20,000*l.* worth of oil per month of the highest quality, well suited to medicinal purposes. The manufacture of the alloys of iron has been commenced, and, in addition, electric furnaces have been erected at Sakchi, primarily for the manufacture of steel for springs, tools, and other purposes, but it is expected that these furnaces will be devoted to the production of ferro-chrome, ferro-tungsten, and other ferro-alloys. The possibility of developing local resources for aluminium, calcium carbide, cyanide, etc., turns on the supply of cheap electric power from the waterfalls of India.

Many chemical problems associated with industry in India await solution, and one of the activities of the Munitions Board has been to mobilise the chemists and allocate to them specific problems for solution. Hitherto, except in a few cases, chemists in India have been mostly employed in the educational departments scattered throughout the colleges, and have not been in touch with industrial problems. This knowledge and talent is now being utilised. A few of the items of research allotted to different chemists may be cited as indicative of the class of work undertaken; these are colloidal medicinal preparations, the causes which render bleaching powder unstable in hot climates, the proportion of suitable chromate by extraction from chrome-iron ore without the use of caustic soda or sodium carbonate, the refining of waste copper, the refining and preparation of several of the essential oils and varnishes, etc. One of the greatest needs of the immediate future is for more organised practical scientific research into the industrial resources of India, alike in forestry, mineralogy, hydro-electricity, and in the industries themselves. This is the factor which is destined to play a decisive part in the establishment of scientific industry in India.

What has already been achieved in the manufacture of optical glass was explained by Sir Herbert Jackson in his lecture at the exhibition, when the chair was appropriately occupied by Sir William McCormick, administrative chairman of the Department of Scientific and Industrial Research. It is not correct to say that this is a new industry, for during about seventy years the firm of Messrs. Chance Bros. and Co., Ltd., of Birmingham, has been making optical glass of high quality. The progress made during the war has been very great indeed, and there is some sense, perhaps, of humility, along with the feeling of pleasure, that this country has been able to do what it has in the matter of optical glass through the pressure of the war. Apart from optical glass, very great strides have been made in what may be generally described as the scientific glassware industry, and Sir Herbert Jackson predicts that the time is rapidly approaching when we shall meet our entire needs for this type of glassware by home manufacture. For this result credit must be given to the close co-ordination between the Ministry of Munitions, manufacturers, and research workers. Indeed, this industry can well serve as an object-lesson for other industries in respect of the application of scientific research to manufacturing processes. The dependence of the chemical glass industry upon the ready supply of raw materials, which with proper attention can be produced here, is illustrated by the difficulties which have had to be overcome in connection with certain raw materials, notably potash. Investigation has shown that for producing some glasses, and X-ray glass is one of them, there are considerable advantages in the use of potash. When this has not been obtainable in sufficient quantity, much work has been required to produce types of glasses good enough to carry on with containing little or no potash. The position with regard to potash, however, gives no cause for fear that in the future, wherever it is required in glass, it will be forthcoming.

After the war the struggle between the various nations anxious to obtain supplies of essential raw materials will be very keen, and it is necessary, therefore, that attention should be given to the development of home resources. Copper is a metal for which the demand will be exceedingly great. At one time Britain occupied an important place in the list of the world's copper producers. But the British deposits are for the most part small, and many have been exhausted, so that our domestic supplies are almost negligible. On the other hand, as Prof. Henry Louis pointed out in his address, the British Empire contains a number of highly important deposits, some of which, like those of Rhodesia, have not yet reached their full development. The copper resources of other Colonies, notably Canada and Australasia, are by no means unimportant, so that even if the British Empire cannot cover all its requirements of copper from its own resources, it can go a long way towards so doing. Other minerals which abound in this country are in need for their full exploitation, Prof. Louis remarked, of sound scientific education for all engaged in the mineral industry.

Mr. Leon Gaster demonstrated in a lecture that scientific illumination is a necessity. He claimed that the provision of appliances needed for artificial lighting is essentially a key industry, and he was able to illustrate that in the factory good lighting is essential to rapid and efficient work, the prevention of accidents, and the health of operators. Illumination is a factor in industry which has hitherto not met with that appreciation which its importance merits, but the possibility of placing the lighting of factories and workshops on the same level as heating and ventilation under the Factory Acts will appreciably alter the position of illuminating engineering. Instruments have been developed for the measurement of illumination—a process essential to scientific method in lighting problems—and the work has already proved of great value in connection with the war.

ROTHAMSTED IN WAR TIME.

THE report of the Rothamsted Experimental Station for the three years 1915–17 is a striking record of triumph over war-time difficulties and of adaptability to the circumstances and needs of the times. On the outbreak of war the staff of the station was rapidly depleted of two-thirds of its members, whilst the call of various Government Departments for assistance by way of investigation has steadily grown. Largely through the assistance of women the emergency has been successfully met and the more important lines of inquiry have been maintained, although the programme of work is naturally undergoing modifications as new problems arise out of the changing agricultural conditions. At the present time the inquiries fall naturally into four groups: the economical use of manures, the ploughing up of grassland, the control of soil organisms, and the nutrition of plants. With regard to the first-named group of inquiries, the summary given in the report of progress made with investigations of the economy of the manure-heap indicates that along two independent lines of inquiry methods have been developed whereby an actual enrichment of the manure-heap or of straw with nitrogen drawn from the atmosphere may be effected. These methods are at present being tested on the semi-practical scale, and, in view of the very large issues involved, the final report will be awaited with the greatest interest.

In connection with the ploughing up of grassland, the problem of coping with wireworm attack is being dealt with, partly by a study of the natural habits of the wireworm in the soil and partly by way of search for some insecticide or method of treatment which will destroy the wireworm and leave the soil suitable for crops. The interesting question of the weed flora of newly broken old grassland is also receiving attention.

The study of the organisms of the soil, which has been so prominent a feature of the work at Rothamsted in recent years, has been steadily maintained, and substantial progress made in the correlation of the protozoan fauna with bacterial activity.

In addition to the foregoing, an astonishing variety of problems has been dealt with in the period under review, and the long list of papers published and of inquiries undertaken at Government request reveals an activity which only the most efficient organisation and strenuous effort on the part of the staff could maintain.

Not least among the achievements of the war period has been the development of the library from a small collection into an imposing array of some 10,000 volumes dealing with agriculture and the cognate sciences, and including an extremely valuable collection of the earliest works on husbandry. Those who have seen the library in its handsome setting and have had occasion to test the merits of the system of indexing so thoroughly carried out will testify to the debt of gratitude which agricultural research workers owe to Dr. Russell for the great work he has accomplished in building up this library at a time when the normal work of the station must have made the heaviest demands upon his energies.

BACTERIA OF ICE AND SNOW IN ANTARCTICA.

THE researches we were able to prosecute during Sir Douglas Mawson's Australasian Antarctic Expedition (1911–14) in the subject of bacterial flora of snow and ice have given rise to certain queries which, if accurately answered and correlated to the work of four previous observers, should go far towards an elucidation of the bacteriology of Antarctica as a whole.

Dr. Ekelöf,[1] whose investigations for nearly two years of the soil of Snow Hill Island, near Graham Land, were rich in results and of great scientific value, made experimental exposures of Petri plates for possible bacteria in the air. He found positive growths on at least half of his culture media, claiming that a Petri plate had to be exposed for two hours for one bacterium to settle on it. His conclusion is, on the evidence of examinations of soil and on account of the unprecedented weather conditions of his Antarctic station, that the organisms he obtained from the air were impurities carried into it by the wind from the soil.

Dr. Gazert,[2] when frozen in the pack-ice to the north of Kaiser Wilhelm II. Land, sought for bacteria in the atmosphere by making cultures of freshly fallen snow. The cultures were found in every instance to be sterile.

Dr. Pirie,[3] during his voyage in the Weddell Sea, exposed plates and tubes in the crow's-nest (at the top of the mainmast) of the *Scotia*, at the longest for twenty hours, with negative results. During the winter months at Scotia Bay he was unsuccessful in similar experiments, as also during the summer. He records, too, that plates of agar and media (for denitrifying organisms) were exposed on top of the deck-laboratory during the voyage in the Weddell Sea in 1903. He considered the last-named cultures to be unsatisfactory, owing to the possibility of contamination from the ship and from spray. "Growths of (apparently) *Staphylococcus pyogenes albus* and of a yellow coccus, possibly *Staphylococcus pyogenes citreus*, were obtained, and also denitrifying organisms."

With this evidence before us it is instructive to learn that Dr. Atkinson, of Capt. Scott's British Antarctic Expedition (1910–13), apparently made bacteriological examinations of snow.[4] "Atkinson is pretty certain that he has isolated a very motile bacterium in the snow. It is probably air-borne, and, though no bacteria have been found in the air, this may be carried in upper currents and brought down by the snow. If correct, it is an interesting discovery."

Lastly, so far back as 1893, it is the record of Nansen in "Farthest North" that he made frequent microscopic examinations during the second summer of fresh-water pools on the floe-ice of the North Polar basin. Algæ and diatoms were proved to germinate at the bottom of these pools, providing the food material of infusoria and flagellata. Bacteria, he says, were occasionally observed. Again, Nansen noticed that in places the surface of the snow was sprinkled with dust, and he was led, after more extended inquiries, to regard the phenomenon as universal over the North Polar sea. He attributes this fact to floating dust being carried by lofty air-currents from southern lands and then descending to the surface in falling snow.

Doubtless, too, one may infer that equatorial air-currents at a high altitude convey myriads of dust-motes towards the South Pole, where they descend, free or clinging to snow-particles, over the great ice-capped continent of Antarctica. And as evidence towards the probable truth of this speculation we have been able to furnish some isolated observations.

The locus of the main base of the Australasian Antarctic Expedition in Adelie Land was singularly fitted for research of a general character on ice and snow, since here the great inland plateau undulates downwards in *névé*-fields, declining gradually for hundreds of miles, to fall abruptly in glacial slopes to the sea. In fact, we were on the verge of the continent, with no naked mountains or outcropping nunataks[5] encircling us to the south, so far as we were able to judge from sledging journeys into the interior. That is to say, there were in the hinterland no indigenous bacteria of Antarctic soil liable to contaminate the ice and snow, and as an additional safeguard, so to speak, there was a continuous torrent of air always blowing towards the north. The average hourly velocity of the wind during our two years' sojourn in Adelie Land was actually almost fifty miles per hour. The main base with its few rocks was at sea-level, and behind it mounted the glacier back to the vast, upland plain which extends southwards, for the most part at a height of 6000 ft., across the crown of the Pole, itself at an altitude of more than 10,000 ft.

[The results which were obtained from an examination of frozen algæ and frozen seaweed led us to inquire further into the bacterial content of the glacier-ice—apparently as pure as distilled water! And so the organic content of frozen algæ makes a suitable point of departure in considerations of a general character, for in these dirty green lumps of ice are represented practically the whole of the low life which exists and actively multiplies in Antarctica: algæ, diatoms (unicellular algæ), protozoa, rotifera, and bacteria. The algæ (including the diatoms) are universally found, according to the scientific reports of other Antarctic expeditions, as marine or fresh-water types in the ice-girt zone surrounding the continent. In Adelie Land one became accustomed to note in the summer-time that certain of the thawed pools among the rocky ridges were filled with a greenish slime—the filamentous, multicellular algæ.]

On comparing results in Adelie Land and in Australia, it is evident that at least four species of bacteria exist in the frozen algæ:—

(1) Gram-positive cocci, with fine, white colonies, liquefying gelatine very slowly, were almost invariably obtained in cultures.

(2) A gram-positive, sporing bacillus spreading as an abundant, pale, wrinkled, and adherent growth on all media.

(3) Gram-positive, chained, sporing bacilli, occurring as a white, profuse growth on all media. In cover-slip preparations of the ice chained bacilli were always seen.

(4) Short gram-positive bacilli, showing on agar a milky-white growth, which afterwards became yellowish in tint.

The fact of the mere presence of bacterial life in frozen algæ would not seem remarkable along the fringe of the continent, where lichens and mosses thrive during the short periods of warmer weather, and where there is a continuous accession of low life from the sea, the soil, and animals. It is only

[1] "Bakteriologische Studien wahrend der Schwedischen Sudpolar-Expedition (1901–3)." (Stockholm, 1908.)

[2] Deutsche Sudpolar-Expedition, 1901–3. "Untersuchungen uber Meeresbakterien und ihren Einfluss auf den Stoffwechsel in Meere."

[3] "Notes on Antarctic Bacteriology." (Edinburgh, 1912.)

[4] "Scott's Last Expedition," vol. i., p. 211. (1913.) We have been unable so far to confer with Dr. Atkinson with reference to his actual results and general conclusions.

[5] The Western Party, under Mr. F. H. Bickerton, discovered a small piece of rock on the snow at a height of 3000 ft., 17 miles south-west of the Hut in Adelie Land. This was afterwards identified in Melbourne by Prof. Skeats and Mr. Stillwell as a meteorite.

natural to expect them, and to infer, further, that they migrate for a variable distance into the all-enveloping mass of ice and snow, to all intents and purposes free from organic life.

Again, in morainic ice—macroscopically pure but for particles of soil and grit in small amount—protozoa-like organisms were present, and in several cultures appeared fine, white colonies of gram-positive, staphylococci, together with the gram-positive, sporing bacilli of the white, wrinkled, adherent growth already described.

When our observations had arrived at this juncture there was a clear indication to go further afield in the examination of the ice; at all events, to see the extent of the local bacterial flora. So specimens were procured from various points, free from obvious contamination, on the ascending glacier.

(1) In a magnetic cave, cut shaft-like through the slope of blue ice, about 1100 yards south of the Hut, at an altitude of 300 ft. above the sea, were found in cultures cocci and diplococci, slender bacilli, and a "yeast." Protozoan organisms were also seen.

(2) In cover-slip preparations 200 to 300 yards, 500 yards, and 1000 yards south of the Hut occurred cocci, motile bacilli, yeast-like bodies, and protozoa.

(3) The surface-ice at 1100 yards, altitude 300 ft., yielded in cultures cocci (staphylococci) and short, stout bacilli.

(4) At one mile, altitude 600 ft. to 700 ft., in surface-ice, appeared in cultures gram-positive staphylococci and slender, gram-negative, chained bacilli. Protozoa and yeast-like bodies were demonstrated in the thawed ice-chips.

(5) In the vicinity of Aladdin's Cave, five miles south of the Hut, and at an altitude of 1500 ft., surface-ice showed the presence of protozoa and yeast-like bodies. Gram-positive cocci grew in cultures on several occasions.

Ice at a depth of 4 ft. contained, besides protozoa and yeast-like bodies, gram-positive cocci and gram-negative bacilli, all in smaller numbers than on the surface. Nothing was obtained in a few cultures.

In ice at 7 ft.—from the wall of the cave—cultures were more successful, demonstrating gram-positive cocci and gram-negative bacilli (probably cocco-bacilli). Protozoans and yeast-like bodies were also present.

(6) From the Cathedral Grotto—at eleven miles, and at an altitude of 1800 ft. above the sea—specimens of ice gave in cultures growths of a gram-positive coccus and a gram-negative cocco-bacillus. No protozoa or yeast-like bodies were observed in the preparations from thawed ice.

(7) In a position fifty miles west of the Hut and twenty-five miles inland, nearly 4000 ft. high on the plateau, surface *névé* (a transition between snow and ice) was found to contain cocci and bacilli in their usual numbers, but no protozoa or yeast-like bodies were seen. Many of the bacilli were clumped in zoogloea masses. From four original cultures and several subcultures were isolated gram-positive cocci and gram-negative cocco-bacilli, similar to those grown from other specimens of glacier-ice.

Then, too, we should adduce the evidence of the cultures made in Antarctica and carried back to Australia for examination.

It was to Dr. J. B. Cleland, of the Bureau of Microbiology, Sydney, New South Wales, that we were indebted for a consignment of freshly prepared culture-tubes which arrived by the *Aurora* on her last cruise of relief in the summer of 1913-14. All the tubes reached Adelie Land in good condition, and, to prevent any possible contamination by mould, had been sealed with paraffin.

On a rare calm day early in January, 1914, six agar tubes were taken, with a spirit-lamp and platinum needle, up the slope of the glacier nearly half a mile towards the south-east, where the glacier could not possibly have been soiled by the many sledging-parties which passed up and down during the summer.

There was no opportunity at the time to go further afield. The sun was bright and warm, there was no wind, and the ice was covered with a humid sheen of moisture. The tubes were inoculated from loops of liquid collected with the needle in small cups where thaw-water had accumulated. They were then carried back to the ship and placed in an incubator, which ran at a temperature varying, during blizzards, from about 10° to 15° C.; as a general rule, the temperature was between 18° and 20° C.

Dr. Cleland's report shows that nine cultures of ice were received, that of these, three showed no colonies, and were discarded, and that the remaining six on agar slopes exhibited growth. From three tubes "yeasts" were isolated, two of them giving a pink growth on agar, the remaining one a creamy-yellow growth. Two cultures showed the presence of a gram-positive coccus, producing a fine growth, which died out in subsequent subcultures.

It is a curious fact, and yet a well-known experience, to find that bacteria may live dormant in ice for prolonged periods, and that infection may be carried through ice, but it is not so generally recognised that some bacteria prefer to grow on ice. Micro-organisms, as a rule, are capable of resisting a low temperature when their ordinary activities cease, and they tend, either as single units or in clusters, to throw out a mucilaginous protein substance for their protection. Ravenel, Macfadyen, and Rowland have demonstrated that several bacilli will bear exposure for a few days to the temperature of liquid air (−192° C. to −183° C.). More recently it has been proved that certain bacteria actually survive the temperature of liquid hydrogen (−252° C.), applied for so long a period as ten hours. Bearing in mind such experiments conducted *in vitro*, we could understand that certain organisms carried by dust-motes to the vicinity of the south geographical pole (at an altitude of approximately 10,000 ft.) could retain their vitality in a temperature of −100° C. (−148° F.), if ever the midwinter temperature descends to such a low limit. Certainly, in the prolonged insolation of the summer-time, some hardy organisms on the surface could thaw out, become free, and increase in numbers.

On the other hand, bacteria and their spores have almost a defined limit of resistance to heat—57° C., if applied long enough. Some germs are thermophilic, mainly those which live and multiply in warm-blooded animals; while others—in general terms, the bacteria of the sea, the soil, and the air—prefer the mean temperature of their environment.

In the Antarctic—and the same holds good of the Arctic regions—there is a definite fauna, comprising in the former case the various species of seals, whales, and birds and their parasites, insect-like mites of the mosses, rotifera, and a fairly prolific marine life. The flora of the south is summed up in the lichens, mosses, and algæ, the last-named having a vast distribution amongst the ice encircling and adhering to the continent. Primordial, lowest of all, and standing as an evolutionary basis of the animal and vegetable kingdom are the bacteria, which we may presume to say are universal—clinging to the myriad dust-motes which float from the north; descending in snow on the Antarctic plateau; paralysed for long winter months; active and acclimatised in the liquid thaw of summer; segmenting or sporing in their multiplication; dormant again in the inter-crystalline canaliculi of the *névé* and ice, and free once more to live and increase in the viable reticulum of the glacier. Such a speculative theory may be the key to their cycle of life in Antarctica.

Liquid containing salts in solution does not completely freeze at a temperature of 0° C. (32° F.), and this factor is very important in the maintenance of low and higher forms of Antarctic life. The late Mr. James Murray,[6] of Sir Ernest Shackleton's British Antarctic Expedition (1907–9), has contributed some unique evidence of the habits and powers of resistance to cold exhibited by the rotifers and water-bears.

"To test the degree of cold which they could stand, blocks of ice were cut from the lakes (saline) and exposed to the air in the coldest weather of the whole winter. By boring into the centre of the blocks we found that they were as cold as the air. A temperature of −40° F. did not kill the animals.

"Then they were alternately frozen and thawed weekly for a long period and took no harm. They were dried and frozen, and thawed and moistened, and still they lived. At last they were dried, and the bottle containing them was immersed in boiling water, which was allowed to cool gradually, and still a great number survived. . . .

"Such is the vitality of these little animals that they can endure being taken from ice at a *minus* temperature, thawed, dried, and subjected to a temperature not very far short of boiling-point, all within a few hours (a range of more than 200° F.). . . ."

It would seem that bacteria were the ideal denizens of an environment where, for the greater part of the year, all visible life is banished, and where their minute size, protective changes of form, and versatile reaction to moisture, low temperature, and concentration of salts would be most advantageous for existence. The bacteria caught up in the frozen sea within the liquid sludge of cryohydrates, which circulates between the crystals of fresh-water ice, learn to live, and probably multiply, in a medium of much higher concentration than the ocean to which they are accustomed.

The question now seems naturally to arise: How are we to explain the existence and multiplication of bacteria in ice? And to satisfy such a query we should endeavour to discover what is the ultimate composition of ice, how the crystals of ice are interrelated, and what are the intimate changes which occur in a descending or rising temperature.

We refer to Mr. J. Y. Buchanan,[7] formerly of the *Challenger* Expedition (1874), for the most modern views of ice-formation.

As a result of many exhaustive experiments on the changes which occur in freezing non-saturated saline solutions, he finds that the crystals formed by freezing a saline solution are in their ultimate constitution free from salt. That is to say that "the crystals formed in freezing a non-saturated saline solution are pure ice, and that the salt from which they cannot be freed does belong to the adhering brine." Therefore, we may imagine that when sea-water freezes the primary solidification which takes place is of the fresh-water content, the salts in solution being rejected into the channels which now exist between the pure crystals. As the temperature is still further reduced, accretions of pure ice go to the crystals, and the brine, still further concentrated, remains in the channelled meshwork.

Buchanan makes the whole matter perfectly clear in the following passage, extending his principle to purer forms of ice, such as glacier-ice:—

"All natural waters, including rain-water, contain some foreign, and usually saline, ingredients. If we take chloride of sodium as the type of such ingredients, and suppose a water to contain a quantity of this salt equivalent to one part by weight of chlorine in a million parts of water, then we shall have a solution containing 0·0001 per cent. of chlorine, and it would begin to freeze and to deposit pure ice at a temperature of −0·0001° C.; and it would continue to do so until, say, 999,000 parts of water had been deposited as ice. There would then remain 1000 parts of residual water, which would retain the salt, and would contain, therefore, 0·1 per cent. of chlorine, and would not freeze until the temperature had fallen to −0·1° C. This water would then deposit ice at temperatures becoming progressively lower, until when 900 more parts of ice had been deposited we should have 100 parts residual water, or brine, as it may now be called, containing 1 per cent. of chlorine and remaining liquid at temperatures above −1·0° C. When 90 more parts of ice had been deposited we should have 10 parts of concentrated brine containing 10 per cent. of chlorine, and remaining liquid as low as −13° C. In the case imagined we assume the saline contents to consist of NaCl only, and with further concentration the cryohydrate would no doubt separate out and the mass become really solid. . . ."

In the case of the glacier-ice of Adelie Land, which we wish particularly to consider, one would expect the ice to be very pure; in fact, the superimposed layers formed from the snow which has fallen should be, presumably, as fresh as distilled water. But assuming, as we do, that a large amount of aerial dust is distributed over the South Polar plateau, and that atmospheric gases are combined with the snow, the ice contains mineral constituents, without doubt, in much more dilute solution than is present in the rain-water of a more temperate climate. And, considering that this contamination by dust-motes has gone on for countless æons, the whole thickness of the polar ice-cap is impregnated with minute foreign bodies.

On dissecting a piece of the glacier we find that a disintegration of the interlocking grains, similar to that which occurs in upturned slabs of sea-ice, takes place on its exposure to the warmth of the sun or to a temperature just below the freezing-point of fresh water. As Buchanan says: "Under the influence of the sun's rays the binding material melts first, the continuity of the block is destroyed, the individual grains become loose and rattle if the block be shaken, and finally they fall into a heap. A block of glacier-ice is a geometrical curiosity. It consists of a number of solid bodies of different sizes and of quite irregular shapes, yet they fit into each other as exactly and fill space as completely as could the cubes referred to above."

Buchanan made his studies of ice on the Alpine glaciers, which, in comparison with the ice-sheet of Antarctica, move rapidly, and, of course, are grossly contaminated by soil, rock, and dust. Still, one of the first phenomena we remarked when stepping on to the ice-foot at Cape Denison, Adelie Land, was the large amount of granular rubble which formed the surface of the glacier. In other words, the summer sun had thawed out all the cementing channels, and the crystals lay melting in a clear slush of liquid.

To a living organism a few micro-millimetres in length a block of glacier-ice not completely solidified would be a veritable labyrinth of minute tunnels filled with liquid containing salts in solution. In every direction the tunnels would be viable, so that a single bacterium might easily pass from top to bottom of the block. The same lump, as an integral part of the glacier, would still be perforated with devious and

6 "The Heart of the Antarctic." By Sir E. H. Shackleton, C.V.O. Vol. ii., p. 228. (London, 1909.)

7 "Ice and its Natural History."

circuitous passages, inosculating with others in the surrounding ice, but the watery contents of these passages would follow laws of movement dependent upon gravity, the slope and movement of the glacier, the presence of small seams and cracks in the ice, and the gradient of temperature from above downwards.

Sufficient has been said to indicate that if in the section of ice we are considering the temperature approaches close to freezing-point, the channels of adhering fluid which encircle the crystals would permeate the glacier down to a definite point where, if the mean annual temperature were low enough, the ice would be solid and impervious. We are led to suppose from Buchanan's observations that the critical temperature of solidification may be as low as $-13°$ C., though in Antarctica, where the ice is purer, it should be 4° or 5° higher. Granting that such a temperature may be several degrees from the actual truth, we may at least be sure that for 5° below the freezing-point of fresh water the glacier-ice of Antarctica is pervious to bacteria, and contains a medium suitable for their reproduction.

In Adelie Land the mean annual temperature at sea-level lies between $-15°$ and $-20°$ C., but on mounting the plateau, which falls steeply to the coast, the temperature descends at the rate of almost 4° for every 1000 ft. In the summer-time the shade temperature registered on several occasions 5·5° C. (40° F.), and for three months at least the temperature, except for unusual fluctuations due to blizzards, never fell much below $-10°$ C., and was very often close to 0° C. Considering, too, that there is a very appreciable amount of sunshine between the equinoxes, the period during which bacterial life and growth would be possible might be extended, during a favourable summer, up to four months. The action of sunlight is of paramount importance in promoting a thaw throughout the ice canaliculi, especially when we remember that the shade temperature may register 0° C. at the same time as the thermometer in the sun rises to 16° C.

The important point at issue is that the northern slopes of the glacier fall towards the sea at such an angle that the rays of the sun for some months during the summer are normal to the surface, thereby increasing the intra-glacial thaw, and for short periods causing the temperature of the whole mass in the lower latitudes to rise within a few degrees of freezing-point, the optimum temperature of the micro-organisms of ice and snow. At the south geographical pole, elevated to 10,000 ft., the obliquity of the sun's rays and the low temperature would not encourage bacterial life except in the surface layers of snow, and that only for a few weeks at the summer solstice. Assuming that the greater part of the continent is at a more or less uniform height of 6000 ft., we should conclude that the organisms which descend from the air are, when buried to a certain depth, wholly deprived of a free-swimming existence, until in the plenitude of ages they arrive at that northern boundary where the summer thaw begins.

It will be apposite now to review the few observations which were made on snow before passing to a few remarks on the meteorology of the southern hemisphere :—

(1) Gram-positive cocci and gram-negative, sporing bacilli grew in culture from snow of a sastruga or snow-wave one-third of a mile south-east of the Hut.

(2) On three occasions when falling snow was gathered in a sterile basin, elaborate precautions having been taken to prevent contamination, the thawed-out samples showed under a cover-slip cocci, motile bacilli, and, invariably, zooglœa masses of bacteria in moderate numbers. Diplococci, and occasionally cocci, were observed to be invested by a pale capsule. In one case doubtful organic matter in the form of vegetable cells was noted.

(3) A *glucose agar slope* culture of falling snow showed a few small greyish colonies, which were not examined.

Slender as these results are, they become of more importance when correlated with the many positive findings made in glacier-ice—the vast repository of the falling snow. They are meaningless, too, unless we consider the probable origin of the bacteria which cling to the crystals of snow.

Regarded simply, the circulation of air in the southern hemisphere has certain main characteristics—a widespread uprush from equatorial, tropic, and sub-tropic zones; a continuous flow at a high level towards the southern continent; a subsidence of successive layers of cool air, increasing in density and coincident with a rising barometric pressure; a concentration of air at high barometric pressure over the vast crown of lofty Antarctica; a relief of pressure in the torrential bursts of blizzards through to the low-pressure belt of the Southern Ocean, and, in wide terms, the genesis of a low equatorial return current modified and deviated by such factors as earth-movement, latitude, disposition of island, sea, and continent, and configuration of the land.

Bacteria or their spores may be found in the atmosphere free, incorporated with minute particles of aqueous vapour, or clinging to small foreign bodies. With these foreign bodies or dust-motes we know that they ascend under the impetus of rising equatorial air into the atmosphere to a considerable height, until at length they come under the influence of the great poleward-flowing current. The bacteria meanwhile have cooled, become paralysed, and, either singly or in segregated masses, thrown out their protective capsule of protein material. They travel to the Pole, and here are frozen to spicules of ice or with the dust which has conveyed them are attached to crystalline snow-flakes, sinking lower with the descending strata of air, and alighting at last on the surface of the plateau.

And now, sparse or in numbers, the frozen organisms, extruded with the dust-mote they accompanied to the periphery of the nuclear snow-crystal, commence a new life-history.

When the snow-flakes—on the plateau of Antarctica snow is mostly in the form of sago-like granules—have recently fallen, they lie together in soft, downy, flocculent heaps enclosing, in proportion to the space they occupy, a large volume of air. Under the influence of gravity and the pressure of the wind, and in dependence, too, on the temperature and humidity of the air, the snow becomes denser and more compact, the enclosed air is expelled, and the snow-crystals increase in size. Thus we may conceive that the bacteria tend to be expelled into the interstices between separate crystals, where they await the time when the temperature will rise sufficiently to provide a liquid medium in which their life and species may be renewed. If the temperature still remains too low for liquefaction of the comparatively impure snow adhering around the primary pure crystal, the slow metamorphosis of the snow into *névé* goes on under more or less dry conditions.

In conclusion, if we trace out briefly the subsequent history of these bacteria of ice and snow, we see them in the slow northward surge of the glacier set floating in ice-tongues and bergs of the Antarctic Ocean, where they gradually thaw out and probably become accustomed to the salinity of the sea. They circulate throughout the immense volume of water, clinging to the plankton of the surface, travelling to various depths, reaching, maybe, the ooze in company with sinking foreign bodies. They migrate in the vast, moving ocean currents towards northern lands, where some remain as marine bacteria; others enter the mouths of rivers and become adapted to life in the fresh-water medium they knew in Antarctica, while still others are stranded on the littoral, whence, in a dry condition, they may be transported by wind to a new soil, assuming, perhaps, the characters of anaerobic bacteria. The cycle—centuries or geological periods in duration—begins once more when, in a temperate zone, the descendants, by an endless gamut of fusion or sporulation of the original organisms, rise on dust-motes and rejoin again the bacteria of the upper air, once more liable to enter the current flowing continuously towards the southern pole of the earth.

A. L. McLean.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The sum of 500,000*l*. has been given to the University of Chicago by Mr. La Verne Noyes for the purpose of the education of soldiers and sailors and their descendants after the war, and for instruction in American history and the public duties of citizenship.

Major E. W. Caldwell, who died from burns resulting from experiments with X-rays, has left from two trust funds upon the death of life tenants provision for a foundation in general educational work in Columbia University. His estate is valued at more than 30,000*l*.

Dr. E. H. Bradford has just retired from the position of dean of the Harvard Medical School. He has been associated with the faculty of the school for thirty-eight years, and an Edward Hickling Bradford fellowship in his honour was recently founded by an anonymous donor of 5000*l*.

Announcement is made by the South-Western Polytechnic Institute, Chelsea, of courses in science and engineering, analytical and manufacturing chemistry, pharmacy, dispensing, food and drugs, metallurgy, assaying and foundry work, botany, geology, and zoology. For further particulars application should be made to the secretary of the institute.

Dr. C. Stephenson, of Newcastle-upon-Tyne, has bequeathed the sum of 5000*l*. to the Royal Veterinary College, London, for the foundation of a Clement Stephenson scholarship; 5000*l*. to Armstrong College, Newcastle-upon-Tyne; and 5000*l*. to the Victoria Benevolent Institution, London, to provide assistance for deserving widows and families of veterinary surgeons.

According to *Paris Médical*, the French universities have recently acquired for the first time the power of conferring honorary degrees. The recipients are to be foreigners who have done signal service to learning, to France, or to the university. In the case of services relating to any particular faculty, an absolute majority of the faculty and a two-thirds majority of the Senate will be required; in other cases the Senate will have to give its approval at two separate meetings. In all cases Ministerial approval will be required.

In connection with the department of technical optics of the Imperial College of Science and Technology, South Kensington, lecture courses have been arranged as follows:—"General Optics," by Prof. F. J. Cheshire; "Optical Designing and Computing," "Practical Optical Computing," "Workshop and Testing-room Methods," and "Microscopes and Microscopic Vision," each by Prof. A. E. Conrady; and "The Construction, Theory, and Use of Optical Measuring Instruments," by Mr. L. C. Martin. Inquiries respecting the courses should be addressed to the registrar of the college.

Two years ago a department of coal-tar colour chemistry was instituted at the Huddersfield Technical College to provide specialised chemical teaching with research facilities for the sudden influx of chemists consequent on the enormous development of the colour industry in Huddersfield. The demand for fully trained chemists is now more insistent than ever, and the recent appointment of Dr. H. H. Hodgson to the headship of the above department is a matter of noteworthy interest. Dr. Hodgson enters his new sphere of activities after nearly three years' successful work as chief chemist for one of the largest firms of chemical manufacturers in the country. Prior to his industrial engagement he was head of the chemical department at the Northern Polytechnic Institute in London. He is the author of numerous original contributions to chemical literature, as well as the translator of five important technological books.

In the recently published "Handbook of Classes and Lectures for Teachers" full particulars are given of some sixty-two courses of lectures arranged by the London County Council to be given during the school-year 1918–19, primarily for teachers employed in teaching within the administrative County of London. Teachers employed elsewhere will be admitted where accommodation permits, but they will be expected to pay an inclusive fee of 7*s*. in respect of each course instead of merely a registration fee of 1*s*. demanded from London teachers. Among the courses arranged may be mentioned that by distinguished authorities on different branches of science dealing with the application of their science to problems of national life and industry. On October 12 Prof. W. J. Pope will lecture on the national aspects of chemistry; on November 2 Prof. W. W. Watts on geology, with special relation to national life; on November 16 Sir A. D. Hall, K.C.B., on the relation of agriculture to the urban population; on December 7 Dr. H. Eltringham on insect-carriers of disease; on January 25, 1919, Prof. W. E. Dalby on engineering with special reference to its relations with our national life; on February 15 Dr. A. Schuster on pure science in relation to the national life; and on March 8 Prof. J. B. Farmer on some aspects of the rubber-growing industry. The lectures will be given in every case at 11 a.m. at the Regent Street Polytechnic, except Prof. Dalby's, which will be at the City and Guilds Engineering College of the Imperial College of Science and Technology, Exhibition Road, South Kensington, S.W.7. Other courses in science include five lectures in the spring term by Sir Rickman J. Godlee, Bart., K.C.V.O., on surgery past and present; eight lectures, commencing on January 21, 1919, at 5.30 p.m., at King's College, by Prof. W. D. Halliburton, on the principles of dieting, with special reference to reduction of food in war-time; and ten lectures on warfare among the lower animals, by Prof. A. Dendy, commencing on October 4, at 5.30 p.m., at King's College.

The issues of the ***British Medical Journal*** and the *Lancet* for August 31 were concerned almost wholly with descriptions of the facilities available in the British Isles for medical education in its different branches. Students are provided in both cases with detailed and clearly stated particulars of how to proceed to graduation in medicine and surgery at the various British universities, as well as how to secure professional qualifications through one of the medical corporations. The *British Medical Journal* points out that between the years 1910 and 1914 the annual entry of first-year medical students averaged roughly 1440. Since the war the number of these entries has increased by five or six hundred a year. Thus the whole number of students actually pursuing medical studies in the medical schools of the United Kingdom has shown a steady upward movement. In May, 1916, the total was 6103; in January, 1917, it was 6682; in October, 1917, it was 7048; while the latest figure, for May, 1918, was 7630. But for some time the large withdrawals of male students from the medical schools for combatant service, or for service as surgeon probationers in the Navy, more than nullified the increased entries, and bade fair to produce a serious deficiency of new practitioners in the years 1918 and 1919. Urgent representations upon this matter were made to the Government. As a result, something has been done to make good the threatened shortage by the return of third-year students from active service to complete their studies, by the retention in the medical schools of students on their way towards qualification who are liable to be called to the colours, and by limiting the period of service of surgeon probationers. The Minister of National Service has further undertaken to provide that, if possible, the supply of students in training shall be kept at a level sufficient to give an annual yield of at least 1000 new practitioners. Another feature of the last four years has been the great increase in the number of women students of medicine. In May last there were 2250 women medical students in the United Kingdom—a figure 23 per cent. greater than the total for January, 1917, and several times larger than in 1914. For this remarkable growth the war must be held mainly responsible.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 19.—M. Ed. Perrier in the chair.—J. **Boussinesq**: Rational solution of the two problems of the punching out and flow of plastic blocks, furnished with a rigid, polished ring.—R. de Montessus de **Ballore**: Plane algebraic curves having common multiple points.—P. **Weiss**: The characteristic equation of fluids. The isochores of hydrogen, according to the measurements of Kamerlingh Onnes and Braak, are rectilinear, and give for the law of expansion $v=b+\mathrm{R}\frac{\mathrm{T}}{p+\Pi}$, where R is the gas constant and Π the internal pressure. For the families of rectilinear isochores studied by the author the relation given by the above equation holds to a degree of precision of the experiments, but R has to be multiplied by a factor greater than 1. Thus it is 1·30 for carbon dioxide. With argon and isopentane the isochores are formed of two straight lines making an angle with each other—that is, the above factor changes abruptly in the case of argon from 1 to 1·39.—C. **Benedicks**: An electro-thermal effect, of which the Thomson effect is a special case.—L. **Gentil**: The neogene deposits of southern Spain.—A. **Sartory**: Sporulation by symbiosis in the lower fungi. Without bacteria being present the perithecium of Aspergillus is not formed. It would appear that under the action of bacteria the medium undergoes a transformation which renders it capable of provoking the production of the perithecium.—H. **Vincent** and G. **Stodel**: The results of antigangrene serotherapy. Details of five cases cured by the use of the serum described in an earlier communication.

BOOKS RECEIVED.

A Calendar of Leading Experiments. By W. S. Franklin and B. Macnutt. Pp. viii+210. (South Bethlehem, Pa.: Franklin, Macnutt, and Charles.) 2.50 dollars.

The Destinies of the Stars. By Dr. S. Arrhenius. Translated by J. E. Fries. Pp. xvii+256. (New York and London: G. P. Putnam's Sons.) 7*s*. 6*d*. net.

Matrices and Determinoids. By Prof. C. E. Cullis. Vol. ii. Pp. xxiv+555. (Cambridge: At the University Press.) 42*s*. net.

Applied Anatomy. By Prof. G. G. Davis. Fifth edition. Pp. x+630. (Philadelphia and London: J. B. Lippincott Co.)

Homeland: A Year of Country Days. By P. W. D. Izzard. Pp. 383. (London: John Richmond.) 7*s*. 6*d*. net.

The Chemistry of Synthetic Drugs. By Dr. P. May. Second edition. Pp. xii+250. (London: Longmans and Co.) 10*s*. 6*d*. net.

Dr. John Radcliffe. By Dr. J. B. Nias. Pp. 147. (Oxford: At the Clarendon Press.) 12*s*. 6*d*. net.

Magnetism and Electricity for Home Study. By H. E. Penrose. Pp. xxiii+515. (London: The Wireless Press, Ltd.) 5*s*. net.

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THURSDAY, SEPTEMBER 19, 1918.

INDUSTRIAL CHEMISTRY.

II.

(4) *Organic Compounds of Arsenic and Antimony.* By Prof. G. T. Morgan. Pp. xx+376. ("Monographs on Industrial Chemistry.") (London: Longmans, Green, and Co., 1918.) Price 16*s.* net.

(5) *Plant Products and Chemical Fertilisers.* By S. Hoare Collins. Pp. xvi+236. ("Industrial Chemistry.") (London: Baillière, Tindall, and Cox, 1918.) Price 7*s.* 6*d.* net.

(6) *A Text-book of Inorganic Chemistry.* Edited by Dr. J. N. Friend. Vol. v. *Carbon and its Allies.* By Dr. R. M. Caven. Pp. xxi+468. (London: C. Griffin and Co., Ltd., 1917.) Price 15*s.* net.

THE breadth of chemical industry is well exemplified in the works under notice. The three mentioned in the first review (NATURE, September 12, 1918, p. 21) cover the heavy chemical, the dye, and the edible oil industries, all requiring many millions of capital, employing thousands of workpeople, and affording problems enough for the most exacting critic.

(4) The three volumes now dealt with show equal diversity, and although Prof. Morgan's monograph deals with a much smaller and more highly specialised section of the chemical industry, it is none the less of considerable importance to establish it in this country. The synthetic organic arsenical compounds were found to be of great physiological potency at quite an early date, though real progress dates only from the beginning of the present century; this fact has very much stimulated later research in the field.

The first discovery of an aromatic arsenical drug was made by Béchamp during the years 1860–63. His compound began to be tried in therapeutics about the year 1902. It was termed "atoxyl" on account of its comparatively non-toxic nature, and employed in the treatment of sleeping sickness.

The success attending these pioneering efforts caused Ehrlich in Frankfort and his many student collaborators systematically to investigate the subject, and Ehrlich and Bertheim showed in 1907 that atoxyl is the sodium salt of *p*-arsanilic acid. Ehrlich carried out researches in a laboratory and private hospital endowed for him by George Speyer, the Frankfort banker, and in collaboration, on the industrial side, with the well-known Höchst colour works. The Béchamp reaction was extended from aniline to other bases, and every possible arsenical derivative was tested physiologically; proof of Ehrlich's zeal is afforded by the story that salvarsan, first obtained in 1909, was the 606th compound to be examined by him. Atoxyl and its homologues are derived from quinquevalent arsenic, but Ehrlich noticed that aromatic compounds of tervalent arsenic were much more effective against diseases of protozoic origin. Salvarsan and its sodium methylene sulphinate, known as neosalvarsan, are the substances chiefly used to-day in the arsenical treatment of syphilis, and it is satisfactory that we are no longer dependent upon Germany for these drugs, which are manufactured here by Messrs. Burroughs Wellcome and Co. and by Messrs. May and Baker, and in France by Poulenc Frères, and possibly by others.

A further discovery made by Ehrlich is the property of arsenobenzene to couple with salts of copper, silver, gold, and platinum in such a way that compounds are formed which can be administered intravenously, when the heavy metal exerts a germicidal action, supplementing that of the aromatic arsenical, whilst at the same time the compound is less toxic to the patient than salvarsan. Such a compound is luargol, prepared by Danysz, and used with considerable success in the French Army. Other valuable organic arsenicals are the primary aromatic arsines discovered by two American chemists, Palmer and Dehn.

The foregoing is only the briefest outline of Prof. Morgan's very fascinating introductory chapter; he rightly points the moral of the need for co-ordinated effort in scientific research which is to have a practical bearing.

For the pure chemist organic arsenic compounds have even greater sentimental interest on account of the part they have played in the early development of the theory of radicles. Bunsen's discovery of cacodyl, as Berzelius named it, and Frankland's explanation of its constitution, were important stages in establishing the constitution of carbon compounds generally.

Prof. Morgan has aimed at giving a complete account of the chemistry of these compounds, dealing with the literature up to the end of 1917, and the value of the text is enhanced, as is nowadays the custom, by a comprehensive bibliography. Successive chapters deal with cacodyl, the aliphatic arsenicals, the aromatic arsenicals, atoxyl, salvarsan, neosalvarsan, the primary arsines, luargol, and the aromatic antimonials, with finally a chapter on miscellaneous derivatives. Lithium antimonyl tartrate has been used extensively by Plimmer and others in the treatment of sleeping sickness, but so far the true organo-antimonials have not been found to equal the arsenical drugs of the salvarsan type.

(5) Agriculture can scarcely be termed a chemical industry, but that side of it which deals with fertilisers is essentially applied chemistry, and justifies its inclusion in this series. Mr. Collins starts from the point of view that the raw materials of agriculture are often the waste products of the other industries, whilst the produce of agriculture again forms the raw material for other industries. His volume covers the cycle from factory to fertiliser, from fertiliser to field, and from field to factory again; it is another of Dr. Rideal's monographs on industrial chemistry.

The opening sections deal briefly with the nature, use, and advantages of the nitrogen, phosphorus, and potash groups of fertilisers. Under the heading of "Mixed Fertilisers" the many questions arising out of farmyard manure and its storage are discussed—the manure heap is still the most unscientific part of the farm—also the vexed subject of the utilisation of sewage.

Part ii. deals with soils and their properties, and the author is able in relatively few words to give a comprehensive account of this vast subject, in which the application of science has made such strides, though it remains more than ever true that the cultivator of the soil himself must determine in every case the dividing line between what is practicable and what is not. The sections on special soil improvers and soil reclamation are most suggestive.

Under the heading "Crops" an outline of photosynthesis is given, followed by sections on the formation of carbohydrates, oil, nitrogenous bodies, and miscellaneous substances, such as tea, coffee, rubber, and fruit. These are all well done, and give a great deal of information in a limited space, much of which is not so generally known to chemists as is perhaps desirable. A point of interest in connection with the increasing production of oil-cake in this country is the opposition of cattle to take readily to new-fashioned food.

Perhaps the most interesting section is that entitled "The Production of Meat." The grazing animal is a machine for converting food of low value to human beings into high-grade food, and there is much to be learnt before this process is fully understood and efficiently controlled. The variety of simple forms of combined nitrogen is large, but whereas some of them are plentiful, others are scarce, and possibly their supply to the animal has to be considered. At present no practical way of obtaining a clear idea of the value of the different proteins in the foods has been discovered. Similarly the production of fats in this country is one of the greatest needs for the future, particularly in times when sea transport is restricted. The climate is unsuitable for the production of vegetable fats, and far greater attention will have to be paid to the pig from this point of view. In discussing future development the financial aspects and the labour question are not forgotten.

Enough has been said to indicate that Mr. Collins has produced a book which is both novel and suggestive, and it deserves to be very widely read.

(6) Without the solid foundation of fact, chemical theories of any kind would not lead far, and it is therefore appropriate to include here a mention of the newest volume of Dr. Friend's "Text-book of Inorganic Chemistry"—namely, that entitled "Carbon and its Allies," by Dr. Caven. Inorganic chemistry to-day is vastly more interesting than a generation ago, when physical chemistry was all but unknown, and the increasing technical importance of many of the less common elements has also added to their interest to the chemist. The elements dealt with are carbon, silicon, titanium, zirconium, thorium, germanium, tin, and lead. For carbon 150 pages of the text are required, which allow of detailed consideration of the allotropic forms, of coal, the simple hydrocarbons, coal-gas, and carbon dioxide. The section dealing with the last is particularly full, and may be quoted as typical of the thoroughness with which the book has been prepared.

The chemistry of silicon has made notable advances during the last few years, largely owing to the researches of British workers on the problems of its relation to carbon, which will be found to be fully considered.

An interesting section is that concerning the constitution of the silicates, which are more definite in composition than the acid itself. The hexite-pentite theory of the Aschs is briefly replained. The author might have made fuller reference to the present industrial uses of silica and of the alkali silicates, the latter especially having very wide application. Titanium is in the main a scientific curiosity, practical interest being limited to its use in steel. The same applies to zirconium, but now that the subject of refractory materials is receiving greater attention we may expect to hear more of it. Thorium is of importance from two points of view—namely, on account of its radio-activity and the use of its oxide in the manufacture of incandescent gas mantles. Both subjects receive very full treatment, and the chapter is one of the most valuable in the book.

Dr. Caven is to be congratulated on having done his work well, and his book will be found to be a storehouse of useful knowledge by all desiring information about the metals mentioned. It is well arranged and clearly printed, both of which facts add much to its usefulness.

E. F. ARMSTRONG.

A THEORIST'S OUTLOOK.

Essays in Scientific Synthesis. By E. Rignano. Pp. 254. (London: G. Allen and Unwin, Ltd., 1918.) Price 7s. 6d. net.

THE editor of the well-known international journal of science, *Scientia,* has done well to give Englishmen, whom he regards as "not attracted by broad generalisations," an opportunity of appreciating in their own language some of the stimulating essays that come from his untiring pen. They deal, indeed, with generalisations of the loftiest scope, but those who cannot follow the author up all the peaks which he seeks to climb will be rewarded by many an interesting view of the solid ground of facts below. The bond uniting the eight essays is that they express the synthetic spirit, and that they are animated by the object "of demonstrating the utility in the biological, psychological, and sociological fields of the theorist, who, without having specialised in any particular branch or subdivision of science, may nevertheless bring into those spheres that synthetic and unifying vision which is brought by the theorist-mathematician, with so much success, into the physico-chemical field of science." We are not sure that "theorist" is the proper title for the generalising thinker like Herbert Spencer, or that Dr. Rignano sufficiently realises the dangers of the synthetician's ambition, but we agree with his protest against the narrow view that all experimentation must be done in a laboratory. What the author really stands for is, that complementary to the work of the experimentalist is the work of the quiet thinker who has had sufficient discipline in scientific method on one hand, and in metaphysical analysis on the other. For this function the book before us is an apologia, and, while it naturally illustrates the risks of the adventure, it also clearly demonstrates its rewards. The second essay gives a luminous exposition of the synthetic value of the evolution-theory. "No other theory, perhaps, has succeeded in bringing into one general survey so many disparate phenomena, and in co-ordinating in one complete complex the numerous individual theories which hold their own in widely differing branches of science, and which, at first sight, seem to have nothing in common." We wish, however, that the author had said something about the fallacy so frequently involved in applying the same word "evolution" to historical sequences which have little in common except that they are processes of becoming.

The central part of the book is undeniably difficult, but it is, as an attempt at least, of great importance. It gives an outline of a mnemic theory of life, which the author has previously expounded in his work on "centro-epigenesis." Let us try to state the main idea without too much of its special terminology. It is quite certain that a relatively simple living creature without any nerve-centres can somehow enregister the results of its experience so that subsequent actions are influenced. That is a relatively simple "mnemic" phenomenon. A set of cells that have taken to some novel metabolic routine, such as secreting an anti-body to some toxin, may keep up the habit long after the original stimulus has ceased to operate. That is another illustration of "mnemic" phenomena. There is some sort of functional inertia in individual organisms—a tendency which in its most fundamental expression is simply to persist in a given phase of moving equilibrium (the word "stationary" used in the translation does not suggest the right idea). Now if the germinal substance is made up of "specific potential elements" which act as accumulators of particular modes of energy—"representative currents," as it is said—it may also be that in the course of the individual development of the offspring there is an activation of these and an irradiation from the centre outwards so that a formative influence is exerted. "The substance of which each of these specific potential elements is composed, which is capable of giving as discharge a single well-determined specific nervous current, is still one and the same substance which this nervous current, when it acts as a 'charging' current, can in its turn form and deposit." In this is found the explanation of the transmission of acquired characters (supposing that to be a fact) and of the recapitulation of phylogenetic stages in ontogeny. It appears to us that the specific form of Dr. Rignano's theory is not in grips with the facts, but to those who believe that experience counts in racial evolution in some other way than either Lamarck or Darwin recognised, every adventure in mnemic theory will be welcome. As to the nervous energy referred to, with its fundamental property of specific accumulation, it is said to obey the general laws of energetics, but is regarded as a monopoly of living organisms. In other words, there is a specific vital energy, as the late Prof. Assheton also maintained.

Organisms strive and cry, they exhibit endeavour and initiative, they are swayed by "affective tendencies." The author seeks to show that these are fundamentally referable to the tendency to maintain physiological integrity or equilibrium. Inborn affectivities with a mnemic basis express themselves in habitual actions, and new habits form new affectivities of the most varied nature. If "habit is second nature," then, inversely, "nature" is nothing but "first habit"—a deliverance that would have pleased Samuel Butler. The author recognises, of course, the complications that are added in organisms with fine brains and strong emotions, that secondary affectivities may come to overrule the primary ones, and so on; but all the apparent "finalism" of life rests on the mnemic property of living substance, which is admitted to be beyond chemical and physical formulation.

We have left too little of our allotted space for the remaining chapters. In answer to the ambitious question, "What is consciousness?" the author maintains that a psychic state is not in itself conscious or unconscious, but becomes one or the other only in relation to some other psychic state. As to the *rôle* of religion, it is argued that its social functions are gradually waning away, having been replaced by other influences. For the individual, however, it is likely to remain, in some form or other, as an expression of man's unconquerable desire to push beyond the frontiers of science and in a stretching out of his hands to relieve his surcharged emotion. Against the fatalistic dogma of "historic materialism" which exaggerates the "inevitable march" of economic processes, the author argues cogently that even in the recognition of the struggle between classes there is on the part of extreme Marxists a welcome contradiction in terms, for the agency of free men with ideas and ideals is thus admitted to be a factor that counts. In spite of its exaggerations, however, the fundamental idea of "historic materialism" has had an important synthetic function in binding together the previously disconnected disciplines of economics, law, and history. The book ends with a dispassionate discussion of Socialism and its future and with a note of hopefulness in recognising the, in part compulsory and in part spontaneous, enlargement and sensitising of the social conscience. We hope to see a continuation of these valuable essays in scientific synthesis, and we would take this opportunity of wishing the author success in his disinterested editorship of *Scientia*, which is an indubitable factor towards true pacifism.

MATHEMATICAL BOOKS.

(1) *Theory of Maxima and Minima.* By Prof. Harris Hancock. Pp. xiv+193. (Boston (Mass.), London, etc.: Ginn and Co., 1917.) Price 10*s*. 6*d*. net.

(2) *Analytic Geometry and Calculus.* By Profs. F. S. Woods and F. H. Bailey. Pp. xi+516. (Boston (Mass.), London, etc.: Ginn and Co., 1917.) Price 10*s*. 6*d*. net.

(1) THE theory of maxima and minima contains pitfalls into which have fallen such well-known mathematicians as Lagrange, Bertrand, Serret, and Todhunter. A peculiar interest, therefore, is attached to the subject, and the reader will find Prof. Hancock's book well worth his study. Except that there is no reference to calculus of variations, the author has succeeded in covering the ground fairly thoroughly, and that without allowing the argument to be anywhere tedious. He gives many references, and a few quite interesting examples.

After a short investigation of maxima and minima of functions of a single variable, he gives in some detail the methods of Scheeffer and von Dantscher, which introduced rigour into the discussion of functions of two or three variables. The theory here is intimately connected with the theory of quadratic forms and singularities of higher plane curves. The author seems not to have read such books as Bromwich's "Quadratic Forms," Hilton's "Linear Substitutions," or Muth's "Elementartheilar," which would have enabled him in places to simplify his treatment of quadratic forms. In tracing a plane curve near a singularity, the author should have made use of Newton's diagram. He should also have avoided such a phrase as "cusps of the first and second kind," which implies that the cusps in question are comparable, whereas the latter is a singularity of much higher complexity than the former.

The chapter on relative maxima and minima is especially interesting. The discussion usually given in the text-books is very scanty, and the fuller treatment here given is very welcome. A valuable point is made in §§ 98–107. The usual proof that the maximum triangle inscribed in a given circle is equilateral runs as follows: "If not, suppose ABC to be the greatest triangle. If AB $\neq$ AC, let D bisect the arc BAC. Then the triangle BDC $>$ BAC, etc." Is this argument admissible? The reader may compare the following reasoning, due to an Italian author: "Unity is the greatest integer. For, if not, suppose n ($\neq 1$) the greatest. Then $n^2 > n$, etc." The proofs run parallel, but the tacit assumption (a greatest triangle or integer exists) is lawful in one case and not in the other.

(2) This work is a revision and abridgment of the authors' two-volume "Course in Mathematics for Students of Engineering and Applied Science," and is intended to occupy a two years' course for an average college class. The book does not give the impression of being especially suited to the needs of students of applied science, except for the fact that examples are included on finding centre of gravity, centre of pressure, and so on. In the main the book is apparently simply a course on pure mathematics designed for the American undergraduate. As such it may be commended as quite clear and readable, and it is furnished with some 2000 well-chosen examples. Naturally it is possible to criticise certain portions on the ground of absence of rigidity. But probably the authors have hit the happy mean between a slovenliness which demoralises the beginner and a precision which terrifies him.

It is interesting to contrast the American and English ideas of a suitable syllabus for the first two years of a "pass" mathematical course. The Americans include the co-ordinate geometry of straight line and plane; but the rest of the syllabus consists almost entirely of the calculus and elementary differential equations. Even the circle and conic receive no more than a passing mention; and very little algebra is inserted, such subjects as determinants and the theory of equations being deferred for subsequent study. Contrast this with a certain English B.A. course, which demands no calculus whatever, but requires the "simple properties of conic sections, including a discussion of the general equation of the second degree and the methods of projection"! The book under review may give the student a somewhat false idea of the importance of the conic (it is mentioned casually along with the witch, the cissoid, and the strophoid), and he may find partial differentiation studied by means of three-dimensional coordinate geometry a little too hard for him. But, nevertheless, English teachers have very much to learn from their allies.

H. H.

OUR BOOKSHELF.

The Botany of Iceland. Edited by Dr. L. Kolderup Rosenvinge and Dr. Eug. Warming. Part ii. 3. Ernst Østrup: "Marine Diatoms from the Coasts of Iceland." 4. Aug. Hesselbo: "The Bryophyta of Iceland." Pp. 348–675. (Copenhagen: J. Frimodt; London: J. Wheldon and Co., 1918.) Price 11*s*. net.

THIS part completes vol. i. of "The Botany of Iceland," the first part of which was issued in two sections, one on "The Marine Algal Vegetation," by H. Jónsson, in 1912, and a second on "The Physical Geography of the Island," in 1914.

The list of marine diatoms from the coasts of Iceland comprises 209 species and varieties; seven species and a number of varieties are here described as new. Mr. Østrup gives a tabular list showing the universal distribution of the forms, as well as their distribution on the different parts of the coasts of Iceland from which it appears that this coastal flora has a predominant European character, but that about one-half of the European species may also occur in colder seas; and, further, that diatom-life is most abundant on the south-west coast. The author also gives a synopsis showing the association of the genera and species of diatoms with the various genera of seaweeds.

The greater part of the book (p. 395 to the end) is occupied with a detailed study of the moss flora of the island, based mainly on Mr. Hesselbo's own collections and investigations. This comprises a systematic list with full notes on the distribution of the species mentioned, and including ninety-three liverworts, twenty sphagna, and 326 true mosses. A full account of the Bryophyte communities follows; first the lowland formations, and secondly the vegetation of mountain heights. Mosses play a very important part in the plant-covering of Iceland, occurring either as an essential component of practically all the plant associations, and often in far greater numbers as regards species and individuals than do the higher plants; or as distinct Bryophyte associations from which other plants are entirely absent, or in which they occur only as a subordinate component. The lowland formations are classified as littoral, hydrophilous or wet-soil, mesophilous, xerophilous (heaths), the vegetation of the rocks, and the vegetation of the lava-fields. The hydrophilous afford the greatest variety, the formations varying with the character of the water or soil; especially interesting are those of the hot springs, which the author describes in some detail. A number of successful photographic reproductions illustrate the prominence of the mosses in the Iceland flora.

The Main Currents of Zoology. By Prof. W. A. Locy. Pp. vii+216. (New York: Henry Holt and Co., 1918.)

THE aim of this book is to explain to the student and to the general reader what have been the main movements in the development of zoology. In the nineteenth century, with which the author begins, the outstanding biological advances were the discovery of protoplasm, the formulation of the cell-theory, the establishment of the doctrine of evolution, the rise of bacteriology, and the beginning of the experimental study of heredity. After interesting chapters on taxonomy and Linnæus, on comparative anatomy and Cuvier, on embryology and von Baer, on physiology and Claude Bernard, the author indicates what seem to him to be the five chief pathways—structural zoology, systematic zoology, general physiology, experimental zoology, and philosophical zoology. This does not seem very satisfactory, for "systematic zoology" is taken to include classification (which belongs to morphology), ecology and study of habits (which belong to physiology); and "experimental zoology" is, as Prof. Locy says, "more a method of general application than a subdivision."

A chapter on insects illustrates a very characteristic modern current, the study of the carriers of important disease-producing organisms, such as those causing malaria and sleeping sickness. Then follows a terse but very clear exposition of theories of evolution. A chapter is devoted to a consideration of the discoveries leading to vaccination and to the use of anæsthetics, with emphasis on W. T. G. Morton's work (1846) in connection with ether. "The ten foremost men of zoological history" are (after Aristotle) Harvey, Malpighi, Linnæus, Cuvier, von Baer, Johannes Müller, Pasteur, Darwin, Max Schultze, and Mendel. The study ends with an estimate of the contributions to zoology made by different nations, and with an emphasis on the international character of science.

There is a copious, well-arranged bibliography, and students will also welcome the series of photographs of great zoologists. Prof. Locy is beyond question right that the educational value of a science is greatly enhanced if the historical setting is made clear, and towards that end his book will be found thoroughly effective.

J. A. T.

A Primer of Engineering Science. By E. S. Andrews. Part i., "First Steps in Applied Mechanics." Part ii., "First Steps in Heat and Heat Engines." Pp. ix+95+67. (London: James Selwyn and Co., 1918.) Price 3*s*. 9*d*. net.

BOTH parts of this book are bound in one volume. Part i. contains chapters dealing with forces, moments, work, power, energy, machines, various types of mechanism, friction, stress and strain. The matter in this part is taken from the author's "Introduction to Applied Mechanics," which was reviewed in NATURE of January 20, 1916. The experimental work described in this part is weak. Six experiments in all are described; the first three only are numbered. Judging from the use made of spring balances in two of the experiments, these appliances have no weight. Part ii. is new, and consists of five chapters dealing with types of heat engines, measurement of heat energy, properties of steam, expansion, indicator diagrams, and the transmission of heat. There are a summary of the contents at the end of each chapter, and also some exercises to be worked by the student. Ten experiments are described in this part. No table of the properties of steam is given; a graph is included, but stops at 100 lb. per square inch; since it is reproduced to a small scale, accurate readings cannot be taken from it. There is evidence of haste in the compilation. On p. 2 the piston ring is described as a "junk" ring; Fig. 6 (*c*) on p. 9 is wrongly arranged; it is stated on p. 39 that Boyle discovered his law in 1862; on p. 50 a diagram traced by an indicator is described as "a diagram of resultant force or effort upon a body." Some of the diagrams are badly reproduced, this being owing to the quality of paper used. Considering the book as a whole, the young student will find some parts interesting and helpful; other parts are treated unsuitably, and a considerable amount of supplementary matter will have to be supplied by his teacher.

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 Shower of Sand-eels.

ABOUT 3 o'clock on the afternoon of Saturday, August 24 last, the allotment-holders of a small area in Hendon, a southern suburb of Sunderland, were sheltering in their sheds during a heavy thunder-shower, when they observed that small fish were being rained to the ground. The fish were precipitated on three adjoining roads and on the allotment-gardens enclosed by the roads; the rain swept them from the roads into the gutters and from the roofs of the sheds into the spouts.

The phenomenon was recorded in the local newspapers, the fish being described as "sile." I was away at the time, but, seeing the account, I wrote to Dr. Harrison, and thanks to him, and especially to Mr. H. S. Wallace, I obtained a sample of the fish, and I was able yesterday (September 5) to visit the place in the company of the latter gentleman.

From those who saw the occurrence we derived full information, which left no doubt as to the genuineness of what had been stated, and this we were able to put to the test, for a further sample was obtained from a rain-barrel which could have got its supply only from the spout of the shed to which it was connected. The precipitation of the fish, we were told, lasted about ten minutes, and the area involved Commercial Road, Canon Cocker Street, the portion of Ashley Street lying between these streets, and the adjoining gardens. The area measured approximately 60 yards by 30 yards, and was thus about one-third of an acre. It is not easy to say how many fish fell, but from the accounts it may be gathered they were numerous; there were apparently several hundreds.

There can be no question, therefore, that at the time stated a large number of small fish were showered over about one-third of an acre during a heavy rain accompanied by thunder; we were informed that no lightning was observed, and that the wind was variable.

All the examples which came into my hands from different parts of the ground and from the rain-barrel prove to be the lesser sand-eel (*Ammodytes tobianus*). They all, moreover, are about 3 in. in length, or 7·5 cm. to 7·9 cm. They are not "sile," a name usually given to the very small young of the herring. But the sand-eels are sea-fish, and it is evident that the sand-eels showered to the ground at Hendon were derived from the sea.

On sandy beaches around our coasts the lesser sand-eel is very common. As its name implies, it burrows into the sand, but in the bays it may often be seen not far from the surface swimming about in immense shoals—shoals which are characterised by the members being all about the same size.

The place where the sand-eels in question were deposited lies about one-quarter of a mile from the seashore, but it is probable that the minimum distance of transport was at least half a mile.

The only explanation which appears to satisfy the conditions, therefore, is that a shoal of sand-eels was drawn up by a waterspout which formed in the bay to the south-east of Sunderland, and was carried by an easterly breeze to Hendon, where the fish were released and deposited. It is significant that the area of deposition was so restricted, and that no other area was affected. The origin and the deposition were therefore local.

We were informed that the fish were all dead, and, indeed, stiff and hard, when picked up immediately after the occurrence. This serves to detract from the possibilities of distribution being influenced by such an occurrence, but it is possible that other species would be able to withstand such an aerial method of dispersion. It is more than probable that the vortical movement of a waterspout would transport plankton. This was naturally not observed in this case, and the small creatures, including eggs and young stages, would likely be carried over a wider area.

A. MEEK.

Dove Marine Laboratory, Cullercoats, September 4.

THE WATER-POWERS OF THE BRITISH EMPIRE.

FOR a number of years NATURE has been, on the subject of water-power in Great Britain, a *vox clamantis*. It has pointed out that while other countries—notably the United States, France, Italy, Switzerland, and even Canada—have possessed hydrographic services, there has been no co-ordinated effort—indeed, one might almost say, no effort of any kind—in this country to procure the information essential to the determination of its water-power resources and their extent and availability. It is true that a merely superficial review is sufficient to show that those resources cannot possibly vie with the vast stores of power locked up in the Alps, the Pyrenees, and the Rockies. Neither, in consequence of the plenitude of our coalfields, has there hitherto been any occasion to trouble in the least about additional, or alternative, sources of power supply. But the war, or rather its unexpected protraction, has of late completely changed the national outlook. The reckless prodigality with which our stores of solid fuel have hitherto been depleted can no longer be countenanced, and the certainty of ultimate exhaustion has to be faced before increasing scarcity causes prices to mount to unremunerative heights. The nation is learning economy, not only in food and clothing, but also in regard to its natural resources and mineral endowments. A salutary experience has been gained, and, though somewhat late in the day, it is satisfactory to know that the position is at last beginning to be fully realised and appreciated.

The Water-Power Committee of the Conjoint Board of Scientific Societies, in their preliminary report, which was abridged in NATURE of September 5, p. 16, has taken a wide and comprehensive view of its functions. The committee has, the report states, "endeavoured to collect all the available relevant information" respecting the amount and distribution of water-power in the British Empire. Turning over the twenty-eight pages of the report, it must be affirmed that the information thus forthcoming is lamentably scant and imperfect. Throughout the length and breadth of the Empire two countries only—Canada and New Zealand—have recognised the fundamental importance of systematic investigation. Initiatory efforts on a small scale have, indeed, been made in Tasmania, New South Wales, and South Africa, but as regards the rest of the Empire there is an entire lack of data upon which to form any trustworthy estimate whatever. No wonder that the committee confesses to a feeling of disappointment and concern.

A very commendable effort was made, in January last, by Mr. A. Newlands, a member of the committee, to direct public attention to the matter, and the statistics which he then put forward in a paper read before the Royal Society of Arts, though admittedly incomplete, serve the useful purpose of furnishing a basis for preliminary estimates in regard to the United Kingdom. As the information was summarised in NATURE of May 9, there is no occasion to dilate upon it here. The committee's comment is that "while the possible water-powers of the United Kingdom are comparatively small, yet, occurring as they do at no great distance from industrial regions, they are relatively valuable, and every effort should be made by close investigation to ascertain their commercial value at an early date."

The outstanding fact, however, about natural supplies of water-power is that their efficient and economic development depends upon the acquisition of extensive data, involving prolonged and laborious observation. It is not sufficient to take a few gauge readings, or to record variations in level over several months, or a year or two. If the investigation is to be of real practical value it must extend over a long series of years. And herein lies the difficulty of dealing, instanter, with a situation which by long neglect has been allowed to become acute. Not until hydrometric studies have completely determined the range of conditions from maximum flood to minimum flow can the design of headworks be safely taken in hand. So, even if observations be commenced to-morrow, a lengthy interval of time, as things are reckoned in these rapid days, must elapse before they are complete enough for action to be taken on them.

In these circumstances it is obvious that where the outcome is at all problematical, or the commercial advantages not strikingly attractive, there will be a reluctance on the part of private individuals to undertake the necessary research work. Scientific bodies, however willing to assist, are certainly not equipped with funds for the purpose. It is natural, therefore, to look to the State to finance such undertakings, the more so as the water-powers, when defined and available, should be exploited, not for individual or merely local benefit, but for the advantage of the whole community.

The committee's report advocates the principle of State initiative. It recommends that the British Government should bring to the notice of the Indian and Dominion Governments the necessity for a systematic investigation of all reasonably promising sources of water-power, and where such an inquiry would be beyond the capabilities of any governing body, the report recommends that it be dealt with by an Imperial Water-Power Board, the constitution of which should be of a widely representative character. Finally, it suggests that "since it is unlikely that private capital will be available for many years for hydraulic development on any large scale, powers should be obtained for the State to assist or to undertake such development if thought advisable."

These are the main conclusions of the report, with the general trend of which we venture to think public sentiment and technical opinion will entirely concur. It now remains to be seen whether any action on the part of the Government will follow. Continued neglect of the matter can only be attended by consequences not merely inimical to immediate national interests, but also economically prejudicial to the welfare of succeeding generations. BRYSSON CUNNINGHAM.

PHYSICAL AND CHEMICAL CONSTANTS.[1]

THE valuable publication before us makes one realise that the country is waking up, if slowly. It is very significant that only in the fourth year of the war a Government Department should be sufficiently alive and receptive to agree to issue a book of constants such as this, bearing as it does on a problem indissolubly bound up with the future of the race.

Both Germany and ourselves have been giving the closest attention to the commercial development of the various processes for the fixation of nitrogen. It was well known that Germany was ahead of us, and the Munitions Inventions Research Laboratory accordingly concentrated on the problem. Its staff soon realised that a detailed compilation of the physical and chemical constants involved was a virtual necessity. Hence the present publication, which is to be regarded as a first instalment of constants compiled by Dr. Todd and his colleagues under the direction of Dr. J. A. Harker, F.R.S., whose name is a guarantee, were one needed, of the soundness of the physics and chemistry of the publication before us, and for which we have nothing but praise.

Considerable skill has obviously been exercised in employing the material to the fullest advantage, more especially in those cases where a scrutiny of the literature served only to show that the data available were meagre. Careful acknowledgment is paid to the several well-known existing books of constants, happily now no longer confined to the German tongue.

But the present work is not to be regarded as a mere compilation of constants. It is a good deal more than that. There are many points in it of considerable technical importance which are very fully discussed, to which the attention of the practical man interested in such problems should be directed.

Half the book is divided into graphs, very clearly executed on a scale sufficiently generous to permit of their accurate and rapid use. In many of these virtually the full area of the page (11 in. by 8 in.) is employed.

1 "Physical and Chemical Data of Nitrogen Compounds." Pp. 96 Ministry of Munitions, Munitions Inventions Department, Nitrogen Products Committee.

The book is divided into five sections (with their associated graphs): general gas data, ammonia data, nitric acid data, hydrogen purification data, and miscellaneous data.

It will suffice to say that in no other publication have we found so adequate and up-to-date a summary of results. One wishes that other branches of physics and chemistry could be treated in a similarly comprehensive manner, and the whole issued as the British answer to "Landolt." It would be large, and doubtless expensive, but imagine its utility! And we need not despair, for we have now got an English Baedeker—blue—and that is only a beginning.

It is not clear from the copy before us to what extent the publication will be available to the general public, or how it may be obtained, or what its cost will be to the would-be purchaser. We trust that there will be no difficulties on these scores, for, both for its own worth and as an earnest of many more good things of the same kind, the present volume deserves a wide circulation.

BIOLOGY AND WAR.[1]

PROF. RAYMOND PEARL makes in the lecture before us an interesting examination of the biological philosophy of war. The primary implements are not mechanisms, but biological entities —men. The primary problems of war are biological problems—why do men fight, what kinds of men make the best fighters, what conditions conduce to the most effective fighting, and what are the probable consequences of the fight to the winner and the loser? "In general, why men deliberately plan wars is because they are different biologically, in structure, habits, mental outlook, thought, or other ways, and wish to preserve intact their differentiations." The group differences have an emotional context of passion, and the modern physiologists have shown us "why rage is more generally followed by fighting than by judicial arbitration." As to the belief, held with particular tenacity in Germany, that warfare is in line with the process of nature selection which has made on the whole for progressive evolution, it must be pointed out that "nowhere in nature does natural selection, as indicated by modern careful study of the subject, operate with anything like that mechanistic precision which the German political philosophy postulates; . . . much less does natural selection operate in a rigid and mechanical manner with reference to human affairs; . . . military results are not, in fact, measured in terms of biological survival." "The plain fact in the matter is that the proudly ruthless philosophy of Treitschke and Bernhardi is not only immorally cruel, but also immortally stupid."

As to the widespread fear that this war will have a serious dysgenic effect by the elimination so many exceedingly desirable types, Prof. Pearl points out that the racial qualities are continued in the females, that many fighters have left progeny before they fell, that a large proportion of the total male population is not involved in the war, and so on. Nevertheless, it seems to us that Prof. Pearl is very optimistic in concluding that "any putative, deleterious, selective effect" of the present war "on the races concerned will be insignificantly slight." Most readers of NATURE will, we believe, know personally of several highly distinguished and markedly original men, whose deaths on the field have left the race, whatever statisticians may say, very definitely the poorer. These unique patterns may recur perhaps; for the present they are gone; and we know not how to replace them.

[1] Lecture given before the Washington Academy of Sciences on May 9, 1918. Journ. Washington Acad. Sci., vol. viii. (1918), No. 11, pp. 341-60.

NOTES.

THE council of the South African Association for the Advancement of Science has resolved to institute a Sir David Gill memorial fund, to accumulate for a number of years until an amount has been raised adequate for some purpose to be decided upon. Mr. R. T. A. Innes, Union Observatory, Johannesburg, has consented to act as the secretary and treasurer of the fund, and intending subscribers are invited to communicate with him.

PROF. H. C. H. CARPENTER, the president of the Institute of Metals, has been nominated to fill the office for a further year.

DR. H. S. HELE-SHAW, F.R.S., and Signor Marconi have been elected honorary fellows of the Society of Engineers (Inc.).

SIR JOHN MARSHALL, Director-General of Archæology in India, has, in consequence of illness, been granted leave of absence, during which his deputy will be Dr. Spooner, Superintendent of Archæology, Eastern Circle.

A COMMITTEE on explosives investigations has been selected by the U.S. National Research Council at the request of the American Secretary of War and the Secretary of the Navy. The committee consists of Dr. C. E. Munroe, of the George Washington University (chairman); Mr. L. L. Summers, of the War Industries Board; Lt.-Col. W. C. Spruance, jun., of the Ordnance Department of the Army; and Lt.-Commdr. T. S. Wilkinson, of the Ordnance Department of the Navy.

DR. J. N. ROSE, a curator of the division of plants, the U.S. National Museum, has gone on a botanical expedition to Ecuador on behalf of the National Herbarium, the U.S. Department of Agriculture, the New York Botanical Garden, and the Gray Herbarium.

DR. OLAF ANDERSON, petrologist at the U.S. Geophysical Laboratory, has resigned his position, having been appointed Government geologist and director of an experimental silicate laboratory at Christiania.

ON September 3 there died in a nursing home in London, only three months after her "Life of Sophia Jex-Blake" had been published, Dr. Margaret Todd, the authoress. Dr. Todd was known to many readers as "Graham Travers," under which *nom de plume* her five novels were written. Dr. Todd, born in 1859, was educated at Edinburgh, Glasgow, and Berlin, graduated in medicine (M.D., Brux.), and was associated in her medical work with Dr. Jex-Blake, the pioneer of the "lady medicals" movement in Edinburgh. Their friendship led to Dr. Todd's becoming Dr. Jex-Blake's executrix and her biographer. To this latter task Dr. Todd brought a triple qualification, the colleague's, the friend's, and the novelist's. Like Mrs. Gaskell's "Life of Charlotte Brontë," it is a woman's life of a woman, is written by a novelist, and reads with all the interest of a novel. Dr. Jex-Blake's biographer depicts her truthfully, a strong, not altogether likeable, personality, strangely emerging from the setting of a patrician English country home, in sharp contrast to the roughness and bitter rancour she endured in Edinburgh. There, supported by such men as Prof. Masson and a small band of staunch friends, she waged war against "a dying tyranny," won the day, and thereby opened a road for those who came after, among them Dr. Elsie Inglis, and others serving to-day with the Scottish Women's Hospitals. Dr. Margaret Todd's last work is an addition to biographical literature, and will help to keep the road-makers unforgotten.

DR. CARL PETERS, the German African explorer, died last week at the age of sixty-two. His first mission to Africa in 1884 was unofficial, and, in fact, discouraged by his Government, but Dr. Peters succeeded in signing a treaty with chiefs on the mainland opposite Zanzibar and laying the foundations of German East Africa. In 1888–90 he made an expedition up the Tana River by Mount Kenia to Lake Baringo, Victoria Nyanza, and back to Zanzibar through Usukuma and Ugoga. Dr. Peters's avowed object was to search for Emin Pasha, but he was more concerned in making treaties with Uganda chiefs. In this, however, he was forestalled by the British. His expedition covered a great deal of ground, and the way was marked by terrorism and brutality, where previous explorers had penetrated with little difficulty. In 1891 Dr. Peters returned to Africa, and in 1892 was one of the commissioners for delimiting the Anglo-German boundary in East Africa. Soon after he was recalled to Germany. In 1899–1901, and again in 1905, he travelled in the Anglo-Portuguese frontier lands in the Zambesi region, and made many important discoveries. This was probably Dr. Peters's best work, though his published results were marred by hasty conclusions and ill-founded judgments on the origin of the Zimbabwe ruins and the extent of early Portuguese work in Africa. Dr. Peters was the author of several works on Africa, including "The Eldorado of the Ancients," published in 1902.

THE publication of the *Monthly Register* of the American Society for Practical Astronomy has been suspended for the duration of the war. The society itself has postponed all further activity for the same period, and no new members are being elected. When the work of the society is resumed the organisation will be as at the close of 1917, the membership consisting of those who were upon the books at that time.

WITH the issue of the *Journal of Anatomy* for October, the publication of the periodical, which is the official organ of the Anatomical Society of Great Britain and Ireland, is to be transferred to the Cambridge University Press, Fetter Lane, E.C.4. Contributions should be sent, as hitherto, to Prof. Keith, acting editor, Royal College of Surgeons, Lincoln's Inn Fields, W.C.2. We wish the journal, which was established in 1867, continued and increasing success.

AMONG the forthcoming free public lectures to be delivered at Gresham College, Basinghall Street, are the following:—Geometry, W. H. Wagstaff, October 8 to 11; Astronomy, A. R. Hinks, November 5 to 8; Physic, Sir R. Armstrong-Jones, November 12 to 15; and Music, Sir F. Bridge, November 19 to 22.

WE welcome the establishment of a new scientific publication, the *American Journal of Physical Anthropology*, with Dr. Ales Hrdlička as editor, supported by a large staff of eminent American anthropologists. The first number, issued for January–March, 1918, contains some important contributions. Mr. G. S. Miller publishes an elaborate study of the famous jaw discovered at Piltdown in 1912. This specimen has been the subject of much controversy, some British anthropologists maintaining that it formed part of the admittedly human cranium close to which it was discovered, while others regarded it as the jaw of a chimpanzee accidentally washed into proximity with a human skull. The latter view is supported in this paper. The combined characters of the jaw, molars, and skull were made the basis of a genus Eoanthropus, of the family Hominidæ. But Mr. Miller asserts that "while the brain-case is human in structure, the jaw and teeth have not yet been shown to present any character diagnostic of man; the recognised features in which they resemble human jaws and teeth are merely those which men and apes possess in common. . . . As the result of recent study the generic features of the jaw and teeth have not been shown to differ from those of living African chimpanzees." The question has probably not reached its conclusion. But the investigation will be assisted by the comprehensive study of the facts and a bibliography of the literature provided by Mr. Miller.

IN the September issue of *Man* Sir H. C. Read discusses a remarkable carved ivory object from Benin, which has recently been presented to the British Museum by Mr. Louis Clarke. At first sight this example scarcely suggests African art, but the representation of a human head wearing a hat connects it with other specimens of Benin art. It is difficult to conceive the precise object of a cover of this peculiar shape. It may have been used as the cover of a vessel, and offerings of some kind may have been dropped into a lower receptacle through the hole in the centre. But no exactly parallel specimen appears to exist in other collections of Benin art, and the object of its construction so far remains a mystery.

IN *Sudan Notes and Records* (vol. i., No. 3, July, 1918) Mr. W. Nicholls describes a remarkable marriage custom in the Sennar province, which is known as "stealing the fire." On the final night of the festivities the bridegroom goes to the bride's house escorted by a band of youths bearing torches. These torches can be lit only by fire taken from the bride's house, and this the relatives of the bride take every possible method to prevent. Some of the bridegroom's friends creep in secretly at night, or a body of them forces its way into the house to carry off the fire. The editor quotes as parallels the custom recorded by Sir James Frazer ("The Golden Bough," "The Magic Art," vol. ii., pp. 216, 230), in which fire is used as a fertility charm in marriage ritual. But this is not an exact parallel, and, assuming that the charm is in the interest of the bride, it does not account for the resistance made by her friends when the bridegroom's party endeavours to procure fire from her home hearth.

THE report for 1917 of the inspectors under the Act restricting experiments on animals has just been published; it can be got from H.M. Stationery Office or through any bookseller, price 2*d*. The total number of experiments in England and Scotland was 55,542, being 10,501 fewer than in 1916; the total number of experiments in Ireland was 832. About 97 per cent. of all experiments were inoculations, or other proceedings performed without anæsthetics. The decrease in the number of experiments goes with the fact that many of our pathologists and bacteriologists are working in one or other of the theatres of war. Indeed, the war is writ large all over this report. Of the twenty new places registered under the Act, fourteen are military hospitals and laboratories, mostly for Canada and New Zealand. Owing to the shortage of men for the work, women are helping; of the 695 licensees, 43 were women. The number of licensees is discounted by the fact that no fewer than 402 of the 695 made no use of their licences during 1917.

REPORTS have recently been received from various quarters of the occurrence in rooms of myriads of little black flies. These not only swarm upon the window-panes, but have also been found in drawers, under carpets, and even behind the glass of framed pictures. Specimens that have been submitted to the Natural History Museum, South Kensington, prove to be *Pteromalus deplanatus*, Nees, a species belonging to the parasitic Hymenopterous family Chalcididæ. There appears to be some uncertainty as to the host-insect that gives rise to such swarms of the parasite. The latter is recorded to have been bred from insects of various orders, *e.g.* a moth (*Tortrix xylosteana*), a beetle (*Ceuthorrhynchus asperulus*), and a Cynipid gall (*Teras terminalis*), but none of these hosts is likely to be the source of origin of such swarms of the parasite indoors; it is probable that in such circumstances it has emerged from one of the wood-boring furniture beetles (*Anobium striatum* or *Xestobium tessellatum*), though there is no definite record of such an origin. Should this prove to be the fact, the Pteromalus, though, perhaps, regarded by the householder as a nuisance, is evidently from its numbers a useful and efficient check upon the insidious and destructive pest of indoor woodwork, whether furniture, wainscotting and panelling, or beams and floorboards. Information of the definite association of the Pteromalus with one of these wood-boring beetles would be welcomed by the Natural History Museum.

MR. CLOUDESLEY BRERETON writes to us in regard to the origin of water-snails and leeches in a small artificial pool in a London garden. The basin, a few square feet in size, was made about three years ago, and one or two water-lilies were placed in it. Two years later some water-snails appeared, and this year three leeches. There is no pool of any sort in adjacent gardens. The water comes from the main. Where have the animals come from? (*a*) They may have been introduced in a young phase along with the water-lilies. The spawn of Limnæa and some other fresh-water snails is deposited on the under-surface of water-plants, and the eggs of some fresh-water leeches are similarly attached. (*b*) They may have been introduced along with the main water—the snails in their larval state, the leeches either when very small or later. On two occasions we have obtained from a house-tap in a large town leeches about 2 in. long. (*c*) Even in transitory rain-water pools the sudden appearance of fresh-water molluscs has been repeatedly observed, and we do not know that any circumstantial explanation has been given. It is probable that water-birds, such as wagtails, may occasionally serve as distributors. Darwin wrote in the "Origin of Species" of just-hatched shells clinging to a duck's foot, and Sir Charles Lyell told him of a water-beetle (Dytiscus) which carried an Ancylus, a fresh-water snail like a minute limpet. Mr. Brereton's observation, which has its counterpart in the experience of others, deserves further investigation.

ENTOMOLOGISTS are still in doubt as to the stage of the life-history in which the common house-fly normally passes the winter. A paper on the subject has been lately published in the *Journal of Agricultural Research* (vol. xiii., No. 3) by R. H. Hutchison, who concludes, from observations and experiments made in Washington, that larvæ and pupæ survive the cold season in and under large manure-heaps, and that breeding may go on through the winter if flies gain access to heated buildings, and find there both food and material suitable for egg-laying.

THE stone-flies (Perlidæ) have hitherto been considered as of no economic importance except that they serve as bait for anglers. A paper by E. J. Newcomer (*Journ. Agric. Research*, vol. xiii., No. 1) is therefore noteworthy, since it records damage to orchard foliage by some species of Tæniopteryx.

THE "Summary of Progress of the Geological Survey of Great Britain for 1917" (H.M. Stationery Office, 1918, price 2*s*.) contains a number of valuable facts relating to the modes of occurrence and probable reserves of iron-ores in Great Britain. Mr. Lamplugh's account of the oolitic ore of Jurassic age revealed by the Dover coal-borings is especially noteworthy, a reserve of about 100,000,000 tons being indicated. Dr. R. Campbell describes Scotch occurrences of potash-felspar.

THE issue of the *American Journal of Science* for July, 1918, contains 416 pages, and commemorates the one hundredth anniversary of the foundation of the journal. The progress of the sciences since 1818 is described in eleven chapters, and the entire cost of the issue has been defrayed from the Silliman memorial fund. In his review of the history of the journal, Prof. E. S. Dana gives a facsimile of the covering title of vol. i., No. 1, which shows that its scope included "agriculture and the ornamental as well as useful arts." The essay on "The Progress of Historical Geology in North America," by Charles Schuchert, contains important remarks on stratigraphy, and the following classification is proposed for the older Palæozoic systems:—Taconic (Olenellus beds), Cambrian, Champlain (Emmons, 1842) or Ordovician, Silurian. The author does not seem aware of Lapworth's support and revival of the term Taconic in 1891. Joseph Barrell, in a philosophic article, reviews the growth of our knowledge of earth-structure; and R. S. Lull deals with vertebrate palæontology, a subject to which the United States have made such paramount contributions. H. L. Wells and H. W. Foote, in the article on chemistry, furnish a table of the elements on Mendeléeff's scheme, in which recent discoveries are included. Attention is directed by the authors to the remarkable compartment in Group III., in which fourteen metals of the rare earths are summarised as "lanthanum 139·0 to lutecium 174·0," the full list being added below. The century's progress in physics is reviewed by L. Page; but W. R. Coe deals only with American developments in zoology. The capture of Louis Agassiz for the United States in 1846 is recorded with warm appreciation.

MR. J. T. JUTSON (Proc. Roy. Soc. Victoria, vol. xxx., part 2, 1918, p. 165) furnishes striking examples of the influence of the crystallisation of soluble salts in promoting rock-weathering in sub-arid regions. He acknowledges his indebtedness to Prof. J. Walther, who directed attention to the subject during the visit of the British Association to Australia in 1914. Level rock floors are developed around lakes, where moisture, containing for the most part sodium chloride, is drawn up by capillarity. The solidifying of the salt disintegrates the rock, and wind removes the *débris*. Caves are eaten out in this way under the marginal cliffs, which recede by a process of dry undermining. A paper by Dr. Bather in the *Geological Magazine* for 1917 is referred to.

A PUBLICATION of importance to zoologists and geologists on "The Foraminifera of the Atlantic Ocean" is begun by Mr. J. A. Cushman in Bulletin No. 104 of the United States National Museum (Smithsonian Institution, Washington, 1918). The Astrorhizidæ are here dealt with, and the evidence of selective ability in these primitive forms is of perennial and philosophic interest. Haliphysema, with its crown of sponge-spicules, is figured after Brady; but photographs are given of *Psammosphaera parva*, which habitually builds into its spherical test one large spicule, projecting boldly at each end. Mr. Cushman writes of another species as possessing "even greater ingenuity."

ONE of the greatest earthquakes of the last ten years was registered on September 3. At West Bromwich the range of movement amounted to 10 in.; the writing pointers were frequently swept off the paper, and were once completely dismounted, the total duration of the oscillations being four or five hours. The origin of the earthquake is estimated to be in the North Pacific, at a distance of 5600 miles, and probably in the Aleutian Islands, which belong to one of the great unstable regions of the globe.

MR. C. H. GLASCODINE, of Abingdon Gardens, W., has sent us an account of a remarkable hailstorm in King Island, Tasmania, on June 21 last, received from his nephew, Mr. E. J. Glascodine, from which we extract the following:—"The hailstones were like starfish, *i.e.* with a roughly spherical core and fingers out in all directions, not only on one plane: more like one of those most useful-looking old-time war weapons, spikes protruding from a sphere of iron in all directions mounted on a handle by a short chain! But in the case of the hailstones the spike was much longer, the largest part of the whole. One or two I measured were more than three inches across from point to point, and several were above two inches in two directions: the centre was comparatively small, from ½ in. to ¾ in. in diameter, roughly. They were not heavy, and were clear ice, not opaque as hail usually is, and at the same time each 'stone' appeared to be an agglomeration of ordinary small hailstones. Though the ground was more or less covered with ice, which lay for two hours, and only a proportion of the hailstones were of extra large size and this unusual shape, the thermometer (on veranda) did not fall below 48° F. All soft, succulent leaves of plants, such as arum lilies and rhubarb, turnip-tops, and such like, were shredded, torn in strips."

IN an article in the September issue of *Scientia* Dr. A. Riccò, of the Astrophysical Observatory of the University of Catania, summarises our knowledge of the constitution of the sun. So far as the interior is concerned, there is still much to learn. The high temperature and pressure which exist there are so much above those attainable in a laboratory that we are unable to ascertain what their effects on the properties of matter are likely to be. There seems little doubt that the temperature of the interior exceeds 7000° C., and is well above the critical temperatures of the substances of which the sun is composed. As a consequence, those substances should be in the gaseous state; but under the enormous pressure to which they are subjected their molecules are so close together that the properties of the gases must be similar to those of liquids, or even solids, as known from laboratory experiments.

IN a paper presented to the Franklin Institute in March, which appears in the August issue of the Journal of the institute, Mr. F. W. Sperr, jun., chief chemist to the Koppers Co., of Pittsburgh, dealt with the relations between the principal characteristics of American cokes and the sources of the coal from which they are produced. In the course of his address he pointed out that more than one-half of the sixty million tons of coke produced per annum in America at the present time is made in the old "beehive" oven, which wastes the ammonia, benzene, naphthalene, toluene, and other by-products the modern oven conserves, and, in addition, will only produce good coke for metallurgical purposes from a much more restricted range of coals than the modern oven. He estimates the annual loss to the country from this cause to be 19,000,000*l*.

THE American Ceramic Society, which has been in existence nearly twenty years, and has hitherto issued its Transactions in the form of annual volumes, has decided instead to publish a monthly journal, the first number of which has just come to hand. The official description of it as "a monthly journal devoted to the arts and sciences related to the silicate industries" serves as a reminder that the authoritative definition of the term "ceramic" in America covers a much wider range than is commonly accepted elsewhere. Possibly this more extensive field may supply at the same time a reason for publication at shorter intervals, and a sufficient amount of suitable matter to maintain the standard aimed at. It is interesting to note that of the committees through which the U.S. National Research Council works, three are concerned with subjects coming within the scope of the American Ceramic Society's activities. An appreciative notice of Prof. E. Orton, jun., who has been secretary of the society since its foundation, is included. Among the technical papers in this first number are:—"Special Pots for the Melting of Optical Glass," by Bleininger; "The Effect of Gravitation upon the Drying of Ceramic Ware," by Washburn; and "Notes on the Hydration of Anhydrite and Dead-burned Gypsum," by Gill. We wish the American Ceramic Society success in its new venture.

READERS of NATURE may be weary of the iteration with which their attention has been directed to the extraordinarily liberal scale on which the American Government subsidises the provision of agricultural education and research, but an article in the current *Fortnightly Review* contains some striking figures which deserve notice. For example, the expenditure of the United States Department of Agriculture has risen from 234,000*l*. in 1890 to upwards of 5,000,000*l*. in 1916—a figure which may be contrasted with the 300,000*l*. odd expended by the English Board of Agriculture in the latter year. Another striking figure is derived from the report of the Division of Publications. The aggregate printed matter issued in one year exceeded 25 million copies of nearly 2000 separate publications, all of which were issued at a nominal price. Another novel form of activity noticed is the employment of "agents in the field" to supply advice gratuitously to the southern coloured agriculturists. Of these 450 were employed. Again, what are known as "corn clubs" for boys have been started. The membership of these exceeds 46,000, and all have been specially instructed in the growing of maize. A sum of 8000*l*. was distributed in prizes for good work. A further respect in which the U.S. Government is far ahead of the British is in relation to the control of food products, especially in respect of adulteration and preservatives, and of this department a characteristic feature is the

"Poison Squad," a band of young men who have volunteered to submit themselves to experiment with suspected foods. The writer of the *Review* article, however, carries his admiration of American administration too far, perhaps, when he says that "the American Government's offices are staffed, not with dull, bureaucratic automatons, not with human derelicts and petrifacts, but with keen, open-minded, and striving business men." This is the same form of psychosis which led before the war to the adulation of German institutions and methods. There is, however, another tribute paid to the American with which more complete agreement can be expressed. "America's chief success," says the writer, "is largely due to the fact that education is the chief industry of the nation." We agree; the American has an intense belief in the value of education and in an aristocracy of brains rather than of wealth. In this respect England has much to learn.

Recalled to Life, a quarterly review devoted to all that is being done for the disabled sailor and soldier, now appears with a new name, *Reveille*, and a new editor, Mr. John Galsworthy in place of Lord Charnwood (H.M.S.O., 2*s*. 6*d*. net). In the issue for August Col. Sir Robert Jones gives a graphic account of the work now being carried out by surgeons in the special military hospitals where disabled men are treated. Experience has shown that the principles which have to be applied in military orthopædic cases are those which were successfully applied in peacetime to children who had suffered from infantile paralysis. Before the war very few surgeons saw more than occasional cases of wounded or divided nerves. Now every convoy from France brings many such cases. The technique of the suturing of nerves has become one of the important points in operative practice. Operations, such as the grafting of bone, the transplantation of tendons, and the plastic reformation of the face or of stumps, which were regarded as surgical curiosities in peacetime, have now become matters of everyday experience. The chief lesson that the military surgeon has learned from recent experience is that the re-education of nerves, muscles, and joints which have been reformed by operation is by far the most important and tedious part of successful treatment. "Muscles," says Sir Robert Jones, "can be made to learn to do things they never did before; bones can be arranged, and the cells will build them up to meet new emergencies; nerve-cells will learn to send messages to the muscles in their new work, and a new limb, as it were, will be created."

According to the *Zeitschrift für angewandte Chemie* for July 2 last, an association of German manufacturers of finely ground dyes, recently formed in Berlin, has been joined by nearly all the firms interested. In addition to watching the economic interests of its members, the new association will act as a central medium for the distribution of raw materials both now and during the transition period.

A large deposit of graphite at Skaland, in Norway, and under the control of the Metallurgists A./S. of Bergen, has been prospected, and now proves to be sufficiently extensive to supply the Norwegian market for some years to come. Any desired quality of product can be made from the crudest material up to one of 97 per cent. purity. Electrostatic separation is adopted. According to U.S. Commercial Reports (May 23, 1918), it is proposed to erect a plant capable of meeting the home demand.

An engineer in Haugesund (Sweden) is at present engaged on an invention in connection with the smelting of molybdenum at a large works near, at which (according to *Verdens Gang*, June 30) it is hoped to refine fifty tons of molybdenum per annum.

Dr. Heinrich Traun and Sons, of Hamburg, have issued a four-page leaflet giving particulars of "Faturan," an insulating material manufactured by them. It is a condensation product of phenol and formaldehyde. It is non-hydroscopic, and scarcely affected by heat. A high insulation is maintained owing to the absence of surface sulphur. Its tensile strength is 2·5 to 3 kg. per mm.^{2}, and its specific gravity 1·2 to 1·3 in normal qualities.

Messrs. Henry Frowde and Hodder and Stoughton have in the press for publication in the series of Oxford Medical Publications "The Early Treatment of War Wounds," by Col. H. M. W. Gray, illustrated, and "War Neuroses and Shell Shock," by Brevet Lt.-Col. F. W. Mott, illustrated. They also announce a new edition of "Surgical Diseases of the Gall-bladder, Bile Ducts, and Liver: Their Pathology, Diagnosis, and Treatment" (including Jacksonian prize essay), by H. J. Waring, illustrated.

OUR ASTRONOMICAL COLUMN.

August and September Meteors.—Mr. Denning writes that between August 28 and September 12 he observed 153 meteors, and determined a number of radiant points of minor showers. The chief of these were as under:—

1918		Radiant ° °	No. of meteors
August 28–September 8	...	0 − 2	8
August 28–September 8	...	265+63	7
September 2–12 ...	...	318+48	10
August 29–September 8	...	326+78	6
August 28–September 12	...	332+ 5	8
August 30–September 8	...	333+57	9
August 31–September 12	...	337 − 10	7
August 29–September 1	...	352+76	8

The Cygnids, No. 3 on the list, were very definitely marked, and that radiant, like several of the others, remains visible during a long period.

On September 8 two large fireballs were seen by Mrs. Wilson at Totteridge at 7h. 20m. and 10h. 14m. G.M.T. The latter was estimated to be four times as brilliant as Venus, and it broke into three pieces in the latter part of its flight. It had a long course of 170 miles, from 10 miles south of Dunkirk to the North Sea about 40 miles north-east of Cromer. Its height was from 64 to 29 miles, velocity 14 miles per second, and the radiant point was at 324° − 25° in Capricornus.

Nova Monocerotis.—A detailed account of the spectrum of Nova Monocerotis, as observed on February 25 and March 1, 15, and 27, has been given by Dr. G. F. Paddock (Lick Obs. Bull., No. 313). The following bright lines were observed in addition to those of hydrogen:—4363, 4640, 4686, 4959, 5007, 5526±, 5677±, 5756±, all being described as faint except the first two and the fifth. As in other novæ, the lines were broad and complex, and each emission band had a faint central absorption band. The bands of hydrogen and 4640 were nearly symmetrical, while the nebulium lines were brightest on the violet sides of the absorption bands. There were no narrow lines suitable for determinations of radial velocity, but the central absorption bands appear to have occupied nearly their normal positions. It is evident that the star had reached the nebular stage in the usual sequence of spectra when these observations were made. At the time of discovery by Wolf on February 4, the magnitude of the nova was 8·5, but previous photographs in the Harvard collection showed that the maximum had already been passed.

THE SPECTROSCOPIC BINARY BOSS 46.—Following the discovery of the variable velocity of this star at Mount Wilson in 1914, Messrs. W. S. Adams and G. Strömberg have made extensive observations, and features of special interest have been revealed (*Astrophys. Journ.*, vol. xlvii., p. 329). The star belongs to the class of spectroscopic binaries in which the calcium lines give values of the radial velocity differing widely from those indicated by other lines. The period is 3·5225 days, and the velocity shown by the hydrogen and helium lines has the remarkably large range of 450 km. per second. The calcium lines have been found to show a variation having the same period, but with the comparatively small range of 20 km. A velocity of −45 km. for the system is indicated by the lines of hydrogen and helium, and of −23·5 km. by the calcium lines. These results seem to favour the view that the vapour producing the calcium lines is not in the form of a detached cloud in space, but is involved in the binary system itself. The differing velocities for the system deduced from the two sets of lines are probably not to be wholly interpreted on the basis of velocity. The visual magnitude of the star is 6·0, and the spectral type B 3 p.

THE INVASION OF TRENCHES BY RATS.

PROF. P. CHAVIGNY has contributed to the *Revue Générale des Sciences* for July 15 and 30 two very interesting and useful articles on the invasion of trenches by rats. Soon after trench warfare began the trenches were invaded by immense numbers of rats, which caused great damage and almost intolerable annoyance at night. Various measures, such as the use of poisons, infective virus, traps, terriers, etc., were taken to destroy the rats, but with very poor success; and it is shown that this was due to a lack of knowledge of the natural history and habits of the animals concerned.

The rat which invades trenches is nearly always the ordinary brown or Norway rat (*Mus decumanus*), but in the case of dry trenches the black rat (*M. rattus*) may be present. These rats sleep in places of retreat or holes during the day; it is at night that they cause all the trouble. The intelligence which they display in overcoming obstacles and avoiding traps, poison, etc., is extraordinary; and it is evident that they possess some means of communicating their knowledge to one another, since any particular means of killing them soon becomes of little use. Prof. Chavigny lays special stress on the fact that they live on exactly the same food as man, and cooked in the same way. Of raw food they can make scarcely any use. For instance, they simply starve if given raw barley. They will gnaw and destroy almost anything that their teeth can penetrate, but what they actually live upon is simply the ordinary human food which they are able to reach, and particularly the remnants from meals. A rat consumes about 30 to 50 grams of food daily, and starvation kills it in about forty-eight hours. It neither lays up stores of food nor hibernates in winter.

As ordinary brown and black rats will not breed in captivity, most of our knowledge as to their rate of reproduction is derived from observations on the albino variety, which breeds readily in captivity. The period of gestation is twenty-one days, and the minimum time between two litters from the same female is sixty-two days. She may have as many as five litters in a year. A litter consists of about ten. A female at the age of two and a half to three months is capable of producing a litter. The young are very efficiently tended, so that scarcely any die. A simple calculation gives the surprising result that a single pair of rats is capable of producing twenty million descendants within three years.

Reproduction ceases during cold weather, and rats cannot reproduce themselves at all in cold climates. In temperate climates reproduction is at a standstill during the winter. The most important factor limiting reproduction is, however, the supply of nutriment. A female receiving only sufficient food to keep her in good condition does not reproduce at all, whereas with superabundance of food reproduction proceeds at its maximum rate.

In his second paper Prof. Chavigny describes and discusses the various methods used for destroying rats, and shows that the disappointing results obtained are due to neglect of the fact that multiplication of rats is simply the result of scattering human food within their reach. The essential step in controlling the rat invasions is to prevent the scattering about of remnants of food. For this purpose it is recommended that, where possible, all waste food should be collected and used for pigs. Where this is not possible the waste food should be thrown into pits and covered with earth before nightfall. Prof. Chavigny proposes also that placards should be posted up saying that "he who sows fragments of food will reap a harvest of rats."

THE PROPERTIES OF COPPER.

THE U.S. Bureau of Standards has recently issued a circular (No. 73) entitled "Copper." It appears that the Bureau is constantly in receipt of requests for detailed or general information concerning the properties, statistics, etc., of metals and alloys. Such information is rarely to be found in systematic form. Generally the different sources of such information are difficult of access, and their accuracy is not always certain. Much information of this kind that is quoted is valueless, either for the reason that the data upon which it is based are incorrect or because they have not been properly interpreted in quoting. Accordingly, the Bureau is planning to issue from time to time circulars on individual metals or alloys with the idea of grouping in them all the most trustworthy information that is available, either from its own tests and investigations or from published records contained in the literature.

These circulars are intended to deal primarily with the physical and mechanical properties of the metal or alloy; all other factors, except a few statistics of production, such as methods of manufacture, impurities, etc., are discussed only in relation to these properties. Copper has been chosen as the first metal for this treatment, partly because much of the accurate information regarding it has been obtained at the Bureau, and partly because our knowledge of its properties is more complete than that of any other metal. Moreover, the commercial forms of copper are characterised by a high degree of purity, *e.g.* the electrolytic wire bar manufactured in the United States of America contains on an average 99·96 per cent. of this metal, and the Lake wire bar 99·89 per cent. The highest quality brands of English (furnace-refined) copper contain about 99·75 per cent.

Circular No. 73 contains the best established values of various physical and mechanical characteristics of pure and commercial grades of copper, principally at the ordinary temperature. Variations of these properties with changes of temperature are also discussed. There is a useful technological section dealing with casting, deoxidation, working, welding, hardening, electro-deposition, and heat-treatment, followed by another discussing the effects of impurities on the physical properties of the metal, and concluding with a brief account of its "diseases." A complete bibliography and typical specifications are included. The information is mainly put in the form of tables and curves, and the latter have been reproduced in such dimensions that accurate interpolation of values on them is possible by the use of a rule graduated in decimal parts of a centimetre. The probable degree of accuracy of data is indicated, or implied, by the number of significant figures in the values given.

It is somewhat surprising to note that pure copper which has been cast and rolled and afterwards annealed at 500° C. to normalise it does not have its ultimate tensile strength stated more closely than 35,000 ± 5000 lb. per sq. in., when it is remembered that after this treatment there is less variation between different samples than in any other condition. Such copper has no detectable elastic or proportional limit; *i.e.* annealed copper takes a permanent set with the slightest loads. On the other hand, when it is cold worked, rolled, or drawn, it does acquire a limit of proportionality, depending on the degree of work. Experiments at the Bureau have shown that modern hard-drawn copper wire is equally affected by drawing throughout the section, and that no hard or exterior skin exists. This has been corroborated by Peirce. The publication is a most useful one. H. C. H. C.

INTERFEROMETER DETERMINATION OF REFRACTIVE INDICES.

PROF. CARL BARUS has recently developed and extended certain of the methods described by him in 1916 in connection with the spectroscopic resolution of interferences obtained with interferometers of all classes from the simplest to the most complicated type.[1] Cases of special interest arise in which the interfering spectra are reversed or inverted relatively to each other.

Obviously, such methods may have a number of valuable physical applications, and among several examples to which Prof. Barus has given attention is the possibility of the determination of refractivity irrespective of form by immersion methods. In the method developed for this measurement (chap. iv., part ii.) the interferences produced by white light in a slightly modified type of Michelson interferometer are viewed with a telescope and prism-grating. Elliptical interferences are seen in the spectrum, which may be moved relatively to spectral lines by a micrometric change of path in one of the beams. A trough containing a liquid of adjustable refractive index, in which the solid under test may be immersed, is placed in this beam, and attempts are made to recognise equality in refractive index of solid and liquid by the fixity of fringes on immersion. Naturally, the fringes in the spectrum are distorted owing to unavoidable differences of dispersion, but it is disappointing that the method should have failed to give a sensitive indication of equality. It has, however, long been recognised that interference methods in most cases are inconvenient for direct refractometry; in reality, the recognition of the point of equality is the crux of the matter, for other more simple and direct methods are available for the measurement itself. In this connection an expedient used by the present writer in attacking the problem (Trans. Optical Soc., December, 1916)—that of varying refractive index in the liquid by differential evaporation while homogeneity is secured by mechanical stirring—might possibly lead to success. The fringes could then be observed continuously and the necessity for separate steps avoided.

The detection of *variations* of refractive index in unworked glass is one of the most important problems for modern optics. These variations, which are due to irregularity of composition, frequently affect the fifth decimal place, but cannot at present be detected until optically worked surfaces have been given to a specimen. It seems possible that the difficulty may be overcome by an interferometer-immersion method. It is too often assumed, however, that interferometer methods are of great delicacy in comparison with "definition" tests or the Töpler knife-edge test. Remembering Lord Rayleigh's rule, that disturbances should meet in an image with not more than a quarter wave-length difference of phase, it may be realised that the formation of a well-defined image is a fairly severe test of the homogeneity of the media of the system, having granted sufficient freedom from aberrations due to the form of the surfaces. If, in addition, the direct image is screened so that only the effects of irregularity are perceived, the test may apparently be made as sensitive as is desired by increasing the intensity of the source of light.

In conclusion, it may be remarked that the method of spectral interferences, although appearing to be exceedingly useful, has not yet been studied so exhaustively in this or other connections as to enable a final judgment to be passed upon it. L. C. M.

[1] "The Interferometry of Reversed and Non-reversed Spectra." By Carl Barus. Parts i. and ii. (Publications of the Carnegie Institution of Washington, 1916 and 1917.)

FERN NOTES FROM PRINCE BONAPARTE'S HERBARIUM.

UNDER the title "Notes Ptéridologiques"[1] Prince Roland Bonaparte is issuing at irregular intervals fascicles of a publication dealing primarily with the fern collections in his private herbarium in Paris. The herbarium already contains about 300,000 specimens coming from all parts of the world. These have been derived partly by purchase or exchange from public or private herbaria or from individuals, and partly from Prince Bonaparte's own correspondents or from collectors and travellers with whom he is in touch. Thus many of the collections are represented in other herbaria, and the publication of the names of specimens which have hitherto been undetermined will be of service to other workers in the field of pteridology, while a systematic account of new collections will add to our knowledge of the ferns and of their geographical distribution. Prince Bonaparte is also pleased to receive on loan collections for determination, and will publish lists of the species.

The general arrangement is geographical, and each collection is treated separately under the heading of the continent from which it has been derived. The systematic arrangement and nomenclature adopted are those of Christensen's Index. A list of desiderata is printed at the beginning of each fascicle.

In an introductory note the older practice of relying solely on external characters for the determination of genera and species is adversely criticised. In the future more use must be made of anatomical characters; thus the scales and hairs, which are becoming increasingly important for systematic distinctions, may appear alike when viewed superficially, but on microscopic examination will reveal well-marked characters useful for specific delimitation. These characters, with those of nervation, will be found more trustworthy than those derived from the indusium, a transitory structure.

These little brochures should prove of considerable value to botanists who are interested in the systematic study of the ferns. We note that the Prince does not follow the rule of giving a brief Latin diagnosis of the new species, though there is often a good description

[1] Paris: Imprimé pour l'auteur.

in French. There is, however, nothing to be said in favour of publishing lists of new species with no description or reference to such, as is done, for example, in the case of a number of Spruce's specimens from tropical South America. The fascicles are separately paged, and an index to each would facilitate reference.

SCIENTIFIC RESEARCH AND NATIONAL PROSPERITY.[1]

MANY, no doubt, do not comprehend what functions the research chemist can exercise in South Africa, and what scope the country can offer for his labours. Following the United States principle of the best men in the best posts, where, they ask, can we place him so that the country may, through his instrumentality, reap the greatest advantage? To answer such questions one needs, first of all, to consider how scientific research—and therefore, inferentially, chemical research—may be distributed. As a matter of convenience a threefold grouping is adopted—university research, industrial research, and national research. Adopting the definitions given by Mr. C. E. Skinner a few months ago at a meeting of the American Institute of Electrical Engineers, we may say that university research includes the pure scientific research, which naturally finds its home in the university, and all other research done there for the purpose of training men. Industrial research comprises all that done by or for industrial concerns with the purpose of advancing industry. National research is that carried on by the Government for the purpose of benefiting the people as a whole. Now it is plain that between these three types of research there can be no sharp lines of demarcation, but university research is often the stepping-stone to industrial advancement, while national research is repeatedly industrial in its objects.

Mr. Skinner rightly holds that the primary function of the university in research should be the training of research men, and that universities should be equipped to turn out research men just as they are now equipped to turn out men with academic and engineering degrees. Prof. G. G. Henderson has laid down the principle that the training of the chemist, so far as that training can be given in a teaching institution, must be regarded as incomplete unless it includes some research work.[2]

The demand for research in almost every field is growing with a rapidity wholly unprecedented, and to the universities alone can we look for men able and ready to take their places in the strenuous effort that is bound to be put forth on every side. We have just inaugurated a triple university system: Prof. Crawford, in his presidential address to this association at Maritzburg, asked, and sought to answer, what South Africa expects from its universities, and referred, in particular, to the need of encouraging the study of science and of furthering research. In developing this theme he asked us to remember that the highest form of research is not made to order, and that there is more in genius than industry and opportunity. It would benefit us to bear this in mind and, in juxtaposition with Prof. Crawford's words, to place a sentence from Mr. Skinner's address:—

"If it takes a genius to recognise a genius yet undeveloped, and properly to stimulate and direct that genius, how necessary it is that we place men of genius at the head of the research departments of our universities!"

It comes to this, then, that we should see to it that our universities are well equipped with scientific research workers, and it is pre-eminently desirable that a system of research professorships should be instituted, the chairs to be occupied by men of enthusiasm, men who will inspire a like zeal and devotion amongst those of the younger generation whom they gather around them, men of personality and character, who will kindle in the breasts of the research students feelings of admiration and respect for them and their work.

"In training research men," says Mr. Skinner again, "the university will naturally become the custodian and the promoter of pure scientific research." Here is the fountain-head whence we shall ultimately draw our men for industrial research and for national research; how important is it, then, that the source of all our supplies should be of crystal purity! Whatever more utilitarian form of research one may afterwards take up, research in pure science is invaluable in the earlier part of the research student's career, for it will give him a zest and a stimulus that will remain with him throughout, enrich his scientific imagination, and adorn all his later work.

At the same time, university research may lead to the most utilitarian results; some of the most important dyes, artificial alizarin, the phthaleins, indigo, and such drugs as phenacetin, antipyrin, and aspirin, were all discovered in university chemical laboratories.

Now why have we so few persons doing research work in South Africa? Is it in part because no research geniuses are born, or is it that we fail to recognise them, and neglect to provide them with the essential facilities?—youths, maybe, on whose humble birth fair Science frowned not, flowers born to blush unseen and waste their sweetness on the desert air, mute, inglorious Miltons whose genius remained latent because we took no trouble to draw it out?

Dr. P. G. Nutting about a year ago said that some writers have spoken of the investigator as a rare individual, to be sifted out from educational institutions with great care for a particular line of work. My personal opinion is that a large percentage of the men students are fitted for research work if properly started along the right line.

What we in South Africa lack—next to the facilities for research—is not so much the research students as the men to start them on right lines. I think that Principal Beattie, at the inauguration of the University of Cape Town three months ago, sounded the correct note in observing that the youth of South Africa did not lack enthusiasm or ability for research, but they lacked opportunity, and, he added, much depended on the men they had as professors. That is the secret of it all. In this dread war South Africans have more than once exhibited a physical courage and a pertinacity equal to anything that Australia or New Zealand could show; why should not South Africa, then, produce a Bragg or a Rutherford as well as Australia and New Zealand, seeing that intellectual courage and pertinacity are two indispensable qualities in a successful research worker? The position is analogous to that which war has developed in Europe and America: there the opportunity has made the man. An American chemist said that "the German General Staff has learned, if others have not, that German chemical achievement, which is great indeed, is no sign that equal ability does not exist elsewhere. The Allies and America improvised a munitions industry in two years to match their machine of forty years' preparation"; and then he

[1] From the presidential address delivered by Dr. C. F. Juritz before the South African Association for the Advancement of Science at Johannesburg on July 8

[2] Report British Association, Newcastle-upon-Tyne, 1916, p. 374.

went on to make a remark which we may well take to heart:—"War could force us to do nothing we did not possess capacity for before."

"The potential research worker," says the editor of the United States *Experiment Station Record*, "is probably less born than made"; and Dr. Nutting thus clothes the same thought in different language:—"Fertility of mind is not so much an inborn quality of the mind itself as of the training and association which that mind has had."[3]

Hence it is our solemn duty as a young nation to provide abundant facilities at each of our three universities for the making of our future research workers.

We pass on to speak of industrial research, which always has some utilitarian end in view, whereas the purpose of pure scientific research is more exclusively philosophic—the discovery of truth. The investigator in pure science has been likened to the explorer who discovers new continents, or islands, or lands before unknown; the investigator in industrial research to the pioneer who surveys the newly discovered land in order to locate its mineral resources, to determine its forest areas, and to ascertain the position of its arable land.[4]

I quote these remarks with all circumspection, for, after all, there are no sharp boundaries between research in pure science and in applied or industrial science, and Huxley was right when he wrote that "what people called 'applied science' is nothing but the application of pure science to particular problems." The fact is that applied science is impossible until a foundation of pure science has been laid to build it on. You cannot apply a science which is not there to apply, and, as Sir William Tinney has said, until men began to interrogate Nature for the sake of learning her ways, and without concentrating their attention on the expectation of useful applications of such knowledge, little or no progress was made.

Industrial chemistry has been defined as that branch of chemical science which uses all the rest of chemistry and much engineering for the furtherance of production of chemical substances, or the use of chemical means or methods for manufacturing any material of commerce; and hence industrial research for the most part differs widely from university research. True, there are instances to the contrary; thus Michigan University has at Ann Arbor a tank for testing ship resistance, and Illinois University has a laboratory for investigations on a full-size locomotive engine; but industrial research is, for the most part, impracticable for universities, and, as often as not, needs to be carried out under large-scale conditions, as it were *in situ*, and by persons already possessing practical experience in the various phases of the problem under investigation. At the same time there should be much closer co-operation between the university and industrial research. Industry should recognise that it must depend primarily upon the universities for its trained research men, and co-operate to the fullest possible extent to the end that properly trained men be turned out.

Do you realise what this last sentence involves—you who are connected with the big industries? It involves that industry should recognise that, from a purely selfish motive, if from no other, its interest lies in endowing research chairs at the universities, and in seeing that they are occupied by men of genius. The very nature of industrial research implies that there must be a constant accession to the ranks of its workers of persons trained in pure scientific research.

[3] NATURE, vol. c., p. 157, 1917.
[4] Col. J. J. Carty: Presidential address. Proc. Amer. Inst. Elec. Engineers, vol. xxxv. [10]. p. 1415, 1916.

If such accession be intermitted, or if the increase of knowledge by means of pure scientific research be hampered, industrial research will inevitably be limited in corresponding degree.

The Government has acted wisely and well in endeavouring to establish a system of industries in this country; do we want these industries to fizzle out, or to go through years of laborious struggling? If we wish to minimise preventable disadvantages of that kind, let us do without delay whatever we can to foster research, so that the men to conduct it may become available as soon as they are needed.

National research approaches more nearly to the industrial than to the university type. It is often undertaken for the advantage of industry in general, but its outlook is considerably broader than that above embraced within the scope of industrial research, restricted, as the latter is, to the requirements of individual industries. In South Africa the cry for industrial research has become more imperative of late, and the Industries Advisory Board, as well as the Scientific and Technical Committee appointed on the initiative of the Minister of Mines and Industries, has gone some distance both in educating the public to the need of this type of research and in giving an impetus in the required direction. Mainly, however, the agencies used were of two classes: the laboratories of the university colleges, and those of certain Government Departments, together with the respective officers of those institutions.

There are two fundamental principles on which I must now lay stress; they are expressed in the words co-operation and co-ordination—co-operation between workers in different branches of science, co-ordination amongst those who work in the same branch in order that the maximum of benefit may be attained. So interdependent, in fact, so interlaced are the three types of research to which I have briefly alluded that it should be patent as the sun at noon that the closest co-operation between them all is essential. It is to be feared that this is not yet so clearly realised as it should be. The waste of time and energy that has risen from overlapping, which in turn has resulted from lack of collaboration, is incredibly great. It has stifled work of value in the past to an extent that is certainly not realised; it has thrown back for many years branches of investigation in which ere now incalculable progress might have been made and untold pecuniary advantages reaped. Would that the dire necessity of this searching war could stir up the South African nation to a correct appreciation of the facts!

About a year ago the president of the Society of Chemical Industry, in his address at Birmingham, insisted on the absolute necessity for the engineer and the chemist to "get into double harness as quickly as possible" and work sympathetically together for the progress of chemical industry. In South Africa, too, this necessity has been manifested, but I am glad to say that we have had more than manifestation; we have had realisation and we have had operation. For example, when, some months ago, the fertiliser scarcity arose, I was deputed to investigate the potentialities of unutilised raw materials in the Union, and found, amongst other things, that there were several thousand tons of good material going to waste in various places in connection with such institutions as slaughterhouses and crayfish canneries for lack of by-products plant to deal with it. When I had completed my tour of inspection and furnished my report, the engineers were charged to follow on, and set to work to make good the deficiency in plant, with the result that a respectable quantity of fertilisers will now be produced from the refuse that hitherto has been going to waste.

May I just repeat here—because they are still applicable to-day—a few remarks which I made in my presidential address to the Cape Chemical Society six years ago?—

"As an industrial science chemistry never operates in isolation. When we concern ourselves with the chemistry of the country's vegetable products it is the science of botany that has to afford additional aid; if it is general agriculture that we are dealing with, the chemist may also have to work in co-operation with the zoologist, entomologist, or mycologist. Often, in connection with the investigation of the country's mineral products and of its agricultural soils, consultation with the geologist is required. In any case, there is this one outstanding fact that these various scientific offices need to be in closest touch with each other in order to promote the smoothest working of the entire machine of investigation as an organised whole.

"This close contact between science and science is of great importance, but it is still more important that contact between the various workers *in one and the same science* should be as intimate as proper co-ordination and organisation can make it. During its annual convention, towards the close of 1910, the American Society of Agronomy was very largely occupied with the standardising of methods for conducting experiments. It was then shown again and again that a large amount of experimental work done in the United States had led to results which could not be compared with each other, were difficult to interpret in a trustworthy way, and were liable to lead to wrong conclusions because there had been no agreement as to method amongst the various institutions involved in the work. We do not wish to have these mistakes repeated in South Africa; our desire is rather to profit by the experience of other lands, but unless we look well to our steps we stand to repeat some of those very mistakes in an aggravated form. Therefore, lest we should go on a wrong track with regard to this matter of investigation and research, two principles should remain deeply graven on our minds: these are co-ordination of effort and unity of plan."

Some of us have read what Mr. H. G. Wells describes as ideal in his "Modern Utopia":—

"In Utopia a great multitude of selected men, chosen volunteers, will be collaborating on this new step in man's struggle with the elements. . . . Every university in the world will be urgently working for priority in this aspect of the problem or that. Reports of experiments, as full and as prompt as the telegraphic reports of cricket in our more sportive atmosphere, will go about the world."

Clearly, co-operation and co-ordination cannot become effective without efficient organisation. We were afforded a splendid illustration of what may thus be effected in the case of a private corporation on the occasion of the Stellenbosch meeting a year ago, when we visited the dynamite factory at Somerset West, and listened to the historical account given by the general manager. Established at the beginning of the present century for the purpose of supplying dynamite to the Kimberley mines, the sphere of operations had so extended that during the twelve months immediately preceding our visit the works had exported to the Commonwealth of Australia more than 100,000*l.* worth of explosive manufactured in South Africa, in addition to supplying our own needs. From that manufacture other industries developed one by one, and the works now include plant for the manufacture of sulphuric, hydrochloric, and nitric acids and of copper sulphate and the nitrates of barium and lead, while others are under consideration. Farmers have been supplied with the sulphur which they need for sheep-dipping and vine-spraying, while 20,000 gallons monthly of a lime-sulphur solution for sheep-dipping have been turned out. The works bid fair to develop into a general chemical factory after the war. Thus far the private concern; what we need in the way of a Government establishment is an institute for research in pure and applied chemistry—such a national chemical laboratory as Prof. Henderson has been longing to see established in England, but England is not yet sufficiently responsive. "We don't conduct research," says Mr. H. G. Wells; "we simply let it happen." Ah, that is where England differs from South Africa; we *don't* let it happen. Sometimes we make ourselves believe that we do, and then we let other things happen to interfere with it. Why, I have been pleading these twenty-four years for a properly organised system of chemical, physical, and biological research with respect to our agricultural soils, and it has not come yet.

The way in which a nation can organise itself and its resources for war has impressed a world. Other nations are talking about organising themselves for the commercial struggle that will ensue upon the termination of the present strife, but mere talking about reconstruction will not enable us to face the future serenely. "We all talk about the weather," said Mark Twain, "but nothing is done!" Why is it that England, France, Australia, New Zealand, and Canada are mobilising their scientific men for research? Dr. G. E. Hale, chairman of the Department of Science and Research of the United States Council of National Defence, says that it is because, "looking ahead, it was seen that the conclusion of peace would be followed by a trade war with Germany, in which no industry not perfected by scientific research could hope to succeed."

Can South Africa compete industrially with a country that has shown us what organisation can achieve, if we starve the very soul of industrial prosperity—pure and applied scientific research carried out in the laboratory?

Mr. W. C. Dampier Whetham, in his recently published book on "The War and the Nation," devoted a section to the organisation of British industry and commerce, in regard to which a reviewer says that "three years of war have done more than a century of peace to impress upon the public mind the indispensability of scientific research to national prosperity." The result has been that the Imperial Government has called into being a department for the express purpose of organising and directing research, and has placed considerable sums of money at this Department's disposal. But perhaps the most important outcome is that "the leaders of British industries have begun to acquire the habit of working together in order to conduct associated researches."[5]

Now let me emphasise the point that there is not one of these industries for which the chemist is not essential at one stage or another. An interesting address given some months ago by the president of the American Cyanamide Company[6] shows how universal the need of the chemist is. Two thousand grades of glassware are required for a vast variety of purposes; for this the skilled glass-maker must work under chemical control. The iron and steel of our cutlery, the extraction of silver, gold, and, in fact, of all metals from the ores, need the chemist at every step; the clothing we wear, the dyes that colour it, and more particularly synthetic dyes, the host of other uses to which cotton is put, the use of cellulose in the form of artificial silk as a new textile material, all are interwoven with the resources of the chemist. The

5 Journ. Roy. Soc. Arts, vol. lxv., p. 755, 1917.
6 *Chem. News*, vol. cxvi., pp. 157-59, 1917.

preparation and preservation of our foods, and the securing of their purity, both depend on chemical control. The manufacture of synthetic drugs, such as antipyrin, phenacetin, sulphonal, veronal, novocaine, aspirin, and salvarsan; the introduction of synthetic perfumes like heliotropin; of synthetic flavours like vanillin; of synthetic rubber and synthetic camphor; the quality of the fuel we use; the efficiency of the fertilisers we put into the soil; the extraction and utilisation of the various animal and vegetable oils, and the conversion of some of them into solid fats by catalytic agency, and so into soaps or candles, with glycerin as a by-product; the production of liquid fuels—every one of these would be impossible without chemical aid.

There are a few facts regarding the chemist which I want every South African, and particularly those in high positions, to realise. First of all, get rid of the idea that he is a druggist or pharmacist, any more than he is a baker or plumber, or belongs to any other avocation in which chemistry takes a share. And then grasp the fact that there is scarcely an avocation on the face of this earth into which chemistry does not enter, or wherein the chemist would not be of some use. One does not need to tell Johannesburg that it has to thank the chemist for its prosperity, for without him many of the mines would long have ceased to work. The other great industry of South Africa, agriculture, is at the mercy of the chemist in respect of the manufacture of fertilisers, and many agricultural products owe to him the processes employed in their preparation. Chemical operations are fundamental to every branch of the dairy industry; the making of jam, the drying of fruit, the tinned vessels in which many of these articles are preserved, are all subservient to the chemist. Without him the economical production of metals of any kind could not take place; there would be no locomotive engines, no assurance that the water which these engines need will not corrode their boiler-tubes, no testing of the coal which converts that water into steam, no provision of steel rails to run the locomotives on, or, to go further, no steel armour for our battleships, and no alloys for shrapnel, aeroplanes, or submarines. It is also the chemist's work to control the driving-power of ships of war and merchandise alike, whether that driving-power be coal, oil, or electricity, for the materials employed by the electrician must all, in the first place, be scrutinised by the chemist.

All explosives are essentially chemical in their make-up, and, in fact, the whole Army, as well as the Navy, is dependent on the chemist all along the line, inasmuch as he has to vouch for the purity of all their supplies of food and drink, even well-water; and not only their natural purity, but also their freedom from fraudulent adulteration or deliberate poisoning. The various gases so much used in the present war are all the productions of the chemist, and so are the means adopted to secure immunity from those gases. It is the chemist who controls the Army's drugs, disinfectants, and anæsthetics. The colouring of the material used for clothing not only the military and naval Services, but the whole civil population as well, is subject to the careful scrutiny of the chemist. His functions also include the manufacture of the leather which provides an army with boots; without him that leather cannot be tanned, as the entire wattle and other tanning industries are conducted under his advice. The finished leather, too, is investigated by him lest fraudulent practices should have participated in its manufacture.

Without the chemist there could be no books, for chemical processes are fundamental to the making of paper, of printing and writing ink, not to mention again the materials wherewith books are bound and the colouring of the binding. The production of illustrations in those books, by whatever means, and also the whole art of photography, must stand or fall with the ability of chemistry to assist them. And then, as I have already said, there is the increasingly large subject of fine and synthetic chemicals, beginning with manufactures like those of starch, glucose, and dextrin, the synthetic dyes which surpass natural products in brilliance and permanence, the synthetic perfumes which far transcend natural odours in potency, the synthetic drugs which have done much to afford relief to the suffering; artificial products—I do not say imitations, for they are often better suited to their applications than the natural products which they replace—artificial products in substitution of rubies, of bone, horn, and ivory, of resins, and of leather, are all the result of chemical research. Again and again the chemist has shown us how to produce the most valuable commodities out of waste and refuse. The refuse of the Bessemer steel-works gave rise to one of our most efficient fertilisers; the refuse of the gas-works provided the world with dyes, drugs, and a marvellously long list of other useful articles; the waste of wool-washeries furnishes us with lanoline. Waste wood, if destructively distilled, and, amongst others, waste wattle-wood, of which large quantities are annually available in Natal, is capable of producing acetone, whereof enormous quantities are now being used for the manufacture of propellants.

So we may rightly claim that the present age is the age of the chemist. The chemist has never before had such opportunity for the application of his knowledge to the betterment of material conditions upon earth, and never has he more effectively applied it to the attainment of this aim. It is also sadly true that never before has he applied his knowledge with such damaging effect as during the present war, but when the war shall have run its course all the chemist's resourcefulness, all his energy, all his persistence will be needed to repair the damage done, and to start exhausted nations upon new lines of industry. On the chemist, more than on anyone else, will this task devolve, and in South Africa in particular he will find abundant work awaiting him. Is he to be there to respond to the call? Then it is for us to educate and train him to the necessary standard; it is for us to provide the means whereby his purpose may be accomplished; it is for us to accord him sympathetic treatment. Do not let us regard him as useful only so long as he is bound down to routine work, and as academic when he is occupied with investigations beyond our limited capacity to understand.

We have heard much during the past four years of the difficulties under which the chemist has been labouring in Britain and America—of the apathetic attitude adopted towards him by Governments, public institutions, and industrial concerns; of the sparing hand wherewith the essentials for the pursuit of his investigations have been doled out to him. I have deemed it very desirable to place before you this evening some of the opinions which have been expressed on these topics north of the Equator, because I am convinced that many of our administrators, politicians, educationists, and commercial men are wholly unaware of the strong remonstrances which have grown to quite a literature during these four years, and are probably under the illusion that in South Africa the chemist has now the opportunity, if he cares to make use of it, to help the Union, with *éclat* to himself, safely through some of the difficulties resulting from the war. I have, in fact, heard such a view seriously expressed; the idea is, of course, perfectly absurd. At the same time it falls to the chemist in particular to do all that in him lies to aid production during this time of crisis, and to assist those directly engaged in the work of production, whether it be the manufactures or agriculture. And those who have it in their power to strengthen the chemist's hands in such a work will themselves be not only aiding the State, but also assisting to bear up the lofty principles for the maintenance of which amongst men Britain and her Allies are contending.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AN effort is being made by the New York University to raise a fund to meet the war emergency conditions. Part of the plan is to secure an endowment of 100,000*l*. for the engineering school in connection with a co-operative scheme of education between the industries and the University. So far the sum of 50,000*l*. has been received.

THE new session of the Sir John Cass Technical Institute, Aldgate, London, commences on September 23. The courses of instruction which have been arranged are directed especially to the technical training of those engaged in trades connected with the chemical, metallurgical, and electrical industries. Full facilities are available for qualified persons who desire to undertake special investigations in connection with these branches of industry. Among the special courses of higher technological instruction which form a distinctive feature of the work of the institute may be mentioned analytical work in fuel and gas analysis, courses on brewing and malting and on the micro-biology of the fermentation industries, and, in the department of metallurgy, courses of an advanced character on gold, silver, and allied metals, on iron and steel, on metallography and pyrometry, and on the heat treatment and mechanical testing of metals and alloys. Detailed information concerning the work of the institute is given in the new syllabus, a copy of which may be obtained on application.

THE summer school of civics and eugenics, which was organised conjointly by the Civic and Moral Education League and the Eugenics Education Society, and held at Oxford from August 10 to 31, was very successful, the programme being comprehensive and attractive, and the courses and meetings well attended. A prominent feature of the school was a civics and eugenics exhibition. The exhibits showed on the civic side the possibilities of regional study with a view to civic service as a part of the school and college work, and on the eugenic side gave illustrations of recent work in heredity and the study of family histories. An exhibit from the National Council of Venereal Diseases was also shown. The following public lectures were delivered:—"The Principles of Co-education," Miss A. Woods; "The Three Voices of Nature," Prof. J. Arthur Thomson; "The Sociological Bearing of Race-study," Prof. H. J. Fleure; "The Influence of Finance on Social Reconstruction," W. Schooling; "The Eugenic and Social Influence of the War," Prof. Lindsay; "The Training College of the Future," Dr. M. W. Keatinge; "Emigration and Eugenics," C. S. Stock; "The Forward Outlook of Eugenics and Civics," Major L. Darwin and A. Farquharson.

THE Indian Bureau of Education at Delhi has issued the first two of a series of short pamphlets in which it proposes to give some account of developments in Indian education which may suggest themselves as worthy of notice. Both pamphlets deal in the main with the sphere of elementary education. The first treats of drawing and manual instruction in Punjab schools. It shows that the same movement is proceeding in India as at home towards providing facilities for the young to learn by *doing* as by talking, listening, reading, and writing. The schemes of instruction follow those adopted of recent date in this country, and several of our own early mistakes are being avoided. Tools and benches are of European pattern. The problem of training teachers is being attacked with some vigour. The second pamphlet is of more general interest. It tells of the humble beginnings of the education of factory children in India, and also children working in tea plantations and on the colliery estate of the East Indian Railway. Descriptions are given of the work going on in all three classes of schools, ranging from the *crèche* to what in England is now called the junior technical school. Above the stage of the *crèche* and the infant school the instruction is that of the part-timer, as a rule, but there are arrangements for evening continuation schooling for older children and adolescents. The vernacular has, as it should have, a more important place than the teaching of English, and the vital importance of manual instruction is recognised. The value of this enterprise can scarcely be exaggerated, for, apart from the fact that the individual is given the opportunity of rising as clerk or, preferably, as skilled workman, there is the likelihood of greater confidence between employer and employed when direct communication is possible, terms of engagement can be clearly understood, and rates of pay calculated. Difficulties abound, and one's sympathy must go out to the pioneers in an uphill task. Mill-owners in Madras, planters in Darjeeling, the railway company, who have actually introduced compulsory education, and officials deserve encouragement.

A PAMPHLET (price 3*d*.) has been issued by the Association for the Scientific Development of Industry, containing the terms of a remarkable address on "The Place and Importance of Science in Education," delivered before the society at Manchester on February 21 last by Mr. Edw. C. Reed. Mr. Reed alludes with satisfaction to the awakened interest of all classes towards science and scientific questions, largely induced, however, by the events of the war, and warmly pleads, with a variety of vivid illustrations, the claims of scientific knowledge and of scientific methods of imparting it as a fundamental part of our educational system. "The result of our neglect of science," he states, "has revealed itself to us in waste, muddle, and inefficiency in practically every department of our national life," whilst, on the other hand, "wherever we have resolutely endeavoured to make good our past deficiencies the effect has been wholly beneficial." From these postulates he proceeds to argue powerfully for a new method and purpose in our educational system. "For every national purpose brains are of more use than bodies," and "the most mechanical job is the better for a little intelligence." But it is not merely on the ground that a training in science and in scientific methods would make the nation more effective in its industrial and commercial activities that the author pleads so powerfully for the inclusion of scientific aims and training in the curriculum of the schools from the earliest period of child-life, but from the much higher consideration that only in so far as this is done can the real, permanent well-being of the nation, both material and spiritual, and of the individuals comprising it, be achieved, and the thesis is worked out with surprising cogency and supported by a wealth of apt allusion. The pamphlet is accompanied by a diagram showing the place of science in the service of man and its importance in industry.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 26.—M. Emile Roux in the chair.—P. **Appell**: The integration of the simultaneous differential equations verifying the Hermite polynomial $U_{m,n}$.—G. **Bigourdan**: The astronomical station at the Petit Luxembourg. The co-ordinates of the stations of the Collége d'Harcourt.—G. **Charpy** and M. **Godchot**: The formation of coke.—M. **Plancherel**: The unicity of the development of a function in a series of Legendre polynomials.—M. **Auric**: The calculation of the energy accumulated in the sun by contraction since its formation.—C. **Raveau**: Is the principle of equivalence a consequence of Carnot's principle? A criticism of a recent paper by Sir Joseph Larmor.—G. **Reboul**: The influence of the radius of curvature of a body on the formation of hoar-frost. Hoar-frost commences to deposit more rapidly on objects the smaller the radius of curvature.—M. **Collignon**: The propagation of the sound of gunfire to great distances. Annual periodicity.—M. **Chopin**: Apparatus for the measurement of chimney losses and the elements constituting these losses. Starting with the approximate formula giving the heat carried away by flue-gases as directly proportional to the difference of temperature between the outside air and the flue, and inversely proportional to the percentage of carbon dioxide by volume, an apparatus is described which reads off directly the percentage of heat lost. The temperature difference is measured by a thermo-couple in the usual way, and for the other factor use is made of the change in electrical resistance of a solution of caustic soda caused by the absorption of carbon dioxide and the production of sodium carbonate. Each of the factors is thus reduced to a galvanometer reading, and the point of intersection of the two galvanometer needles is read off on a series of curves plotting the percentage heat loss. The apparatus in its present form is not automatic.—H. **Colin** and Mlle. A. **Chaudun**: The law of action of sucrase: the hypothesis of an intermediate combination. The results of six series of experiments are given, from which it is shown that the theory of A. Brown, which assumes a combination between the sugar and the enzyme, is justifiable.—F. **Kerforne**: The iron minerals of Menez-Bel-Air (Côtes-du-Nord).—C. **Viola**: The law of Curie. Curie's law is defined as follows: The normal increases of the faces of a crystal in stable equilibrium are directly proportional to their capillary constants, and some mathematical consequences are developed.—A. **Piédallu**: The industrial application of the colouring matter of the glumes of the sugar sorghum. Details are given of the method of extracting the dye, and of its application with different mordants to dyeing wool, silk, and cotton.—M. **Galippe**: Researches on the resistance to heat of the living elements existing normally in animal and vegetable tissues.—P. **Girard** and R. **Audubert**: The electric charges of micro-organisms and their surface tension.—R. **Paucot**: The measurement of arterial pressure in clinical practice. A criticism of current methods of measurement and suggestion of a new technique.

September 2.—M. Paul Appell in the chair.—E. **Cartan**: Varieties of three dimensions.—P. **Straneo**: The extension to physics of the principles of homogeneity and similitude, and a remarkable relation between the universal constants of a theory.—P. **Weiss**: The characteristic equation of fluids. The equation proposed is of the form

$$\left(p+\frac{a}{v^2}\right)(v-b)=\zeta RT,$$

here R is the gas constant for perfect gases. This equation with four constants, a, b, η, ... represents with precision the properties of a fluid in one of the states corresponding with a family of isochores.—F. **Dienert**: The estimation of nitrites. The proposed method is based on the liberation and estimation of iodine from an acidified solution of potassium iodide by the nitrite in an atmosphere free from oxygen.—P. **Gaubert**: The artificial coloration of spherolites of helicoidal formation (tartrates and bimalates).—H. **Hubert**: The influence of the lithological nature of formations relatively to the distribution of the surface and underground waters north of the Senegal River.—L. **Gentil**: The geology of Andalusia.—M. **Lecointre**: Some recent fossil-bearing strata in the neighbourhood of Casablanca, Western Morocco.—F. **Masmonteil**: The morphology of the antibrachial skeleton.—P. **Godin**: The transformation into pedagogic indications of the data of anthropology on the individual nature of the child of both sexes.—A. **Vernes**: The colorimetric measurement of syphilitic infection.—S. **Voronoff** and Mme. Evelyn **Bostwick**: The intensive acceleration of the budding of wounds by the application of testicular pulp.

BOOKS RECEIVED.

Medicinal Herbs and Poisonous Plants. By Dr. D. Ellis. Pp. xii+180. (London: Blackie and Son, Ltd.) 2*s.* 6*d.* net.

The New Science of the Fundamental Physics. By Dr. W. W. Strong. Pp. xii+108. (Mechanicsburg, Pa.: S.I.E.M. Co.) 1.25 dollars.

Present-day Applications of Psychology, with Special Reference to Industry, Education, and Nervous Breakdown. By Dr. C. S. Myers. Pp. 47. (London: Methuen and Co., Ltd.) 1*s.* net.

War Neuroses. By Dr. J. T. MacCurdy. Pp. ix+132. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

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

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THURSDAY, SEPTEMBER 26, 1918.

APPLIED OPTICS.

Applied Optics: The Computation of Optical Systems. Being the "Handbuch der angewandten Optik" of Dr. Adolph Steinheil and Dr. Ernest Voit. Translated and edited by J. Weir French. Vol. i. Pp. xvii + 170. (London: Blackie and Son, Ltd., 1918.) Price 12*s.* 6*d.* net.

THE first volume of Steinheil's handbook appeared twenty-eight years ago, and the promised second and third volumes of the work never materialised, probably owing to the first meeting with insufficient appreciation. The book before us is a translation of the first half of Steinheil's first volume, and the fact that a prominent member of one of our foremost optical firms (Barr and Stroud) considered it worthy of this labour is eloquent proof of the truth of a statement by the late Prof. Silvanus P. Thompson in a noted outburst:—

"The simple reason of the badness of almost all recent British text-books of optics is that . . . they are written, not to teach the reader real optics, but to enable him to pass examinations set by non-optical examiners. The examination-curse lies over them all."

Steinheil's book certainly does not belong to this category; it is severely practical and almost crude in its empiricism. Scarcely any of the numerous formulæ given in the book are proved; the reader must either accept them and mechanically follow the scheme of the numerous numerical examples, or he must discover the proofs by his own effort. In the case of the complicated Seidel-formulæ for rays not proceeding in a plane containing the optical axis, a student unfamiliar with modern spherical trigonometry is not likely to succeed in this, and the proof of these formulæ, together with a clear explanation of the adopted method of astronomical computation with angles up to 360°, should certainly have been included in this first volume of the translation instead of being relegated to the promised second volume.

The Steinheil system of symbols is safe, but cumbersome, on account of the multitude of suffixes; the use of precisely the same symbols for paraxial and for marginal rays is, however, likely to cause confusion. The sign-conventions agree in all ordinary cases with those almost universally adopted by practical computers; the only defect in them is that all the signs are made to depend on the direction in which the light travels through the system; hence if the latter includes reflecting surfaces—a case expressly and necessarily included in the scheme—the signs of all the angles and intersection-lengths must be reversed before proceeding to the following surface. This complication is entirely avoided if the direction of the light is ignored and axial intercepts are given the sign usual in analytical geometry, and if the acute angles between the optical axis and the ray are called positive when corresponding with a clockwise turn.

The worst feature of the book is to be found in the definitions of the various aberrations, which are not only loose, but also frequently positively incorrect. Thus on p. 45 the important sine-condition is merely implied—and only in the form which it takes for systems applied to infinitely distant objects. The condition is correctly stated in its general form on p. 57, but the statement is immediately vitiated by the assertion that it is fulfilled "when the system has the same true focal length for any portion of the whole aperture"—*i.e.* when it is fulfilled for infinitely distant objects. With rare exceptions, in the case of certain systems having great thickness or wide separations, the exact contrary is true: A system fulfilling the sine-condition for objects at infinity does *not* fulfil it for objects at finite distances.

The worst confusion of this kind occurs in the case of distortion. On p. 44 this is correctly, although loosely, defined in its accepted meaning. Throughout the rest of the book the term is used for the defect universally known as coma, simply because the latter, by diffusing the rays over a certain area, necessarily causes most of them to fall away from the position of the ideal image-point. Steinheil thus ignores the fact that true distortion may exist in an otherwise perfect image, and that it causes a linear displacement of any image-point which is proportional to the third power of its distance from the optical axis, whilst the coma-displacement is proportional directly to the distance of an image-point from the optical axis, and also to the square of the aperture of the image-forming cone—which latter has no effect at all on true distortion.

On p. 56 coma is described as "spherical aberration out of the axis," which, again, is wrong; true spherical aberration may exist in oblique pencils independently of that on the optical axis, but it is a fifth-order aberration which has nothing to do with coma.

There are many other cases of a type similar to the above examples.

The book is beautifully printed on paper of extraordinary thickness, and the translator and editor may be congratulated on the excellence of his part of the work.

A. E. C.

THE MEGALITHIC CULTURE OF INDONESIA.

The Megalithic Culture of Indonesia. By W. J. Perry. Pp. xiii + 198. (Manchester: At the University Press; London: Longmans, Green, and Co., 1918.) Price 12*s.* 6*d.* net.

IN his presidential address to Section H (see NATURE, vol. lxxxvii., p. 356), at the meeting of the British Association at Portsmouth in 1911, Dr. Rivers explained how he had been led to reject the popular dogma of "spontaneous generation" in ethnology, which is wrongly claimed to be "evolution," and to realise the vast importance in the development of civilisation of the influence exerted by the contact of peoples and the diffusion of culture. When he recognised that the germs of the megalithic culture of Melanesia had been troduced from the west it was clear that the immediate problem for investigation was to determine whether the Malay Archipelago, the scattered islands of which convert the great waterway linking the Indian and Pacific Oceans into a sort of sieve, had preserved any records of the earliest of the cultural streams which must have been filtering through it for twenty-five centuries. He therefore recommended Mr. W. J. Perry (who had been sent by Dr. A. C. Haddon to seek his advice as to the choice of a subject for investigation in ethnology) to learn the Dutch language and to search the voluminous, though scattered, literature of Indonesian ethnology for any evidence of the easterly diffusion of megalithic culture.

The book before us is the first substantial instalment of the results of this investigation; and it is certain to become a landmark in the history of ethnology. For it represents a noteworthy advance in the process of introducing the true methods of exact science into a domain of knowledge which for fifty years has been rendered increasingly chaotic by the misuse of biological terms and the misunderstanding of psychology.

An incursion into this maze of confusion by a man fresh from the severe discipline of the Mathematical Tripos might be expected to produce surprising results—and this expectation is fully justified in Mr. Perry's book. For he has impartially collected all the available facts, and based his explanation of them on the evidence they provide, without attempting to force them into any ready-made scheme, such as Waitz, Bastian, and Tylor have constructed, or to evade the issues so raised by taking refuge behind the blessed phrases "animism," "totemism," "intertribal barter," "sympathetic magic," "similarity of the working of the human mind," or any of the other catchwords that the modern ethnologist has been taught to use as substitutes for inquiring into the real meaning of things.

Mr. Perry was able not only to realise Dr. Rivers's expectations by finding the megalithic culture-complex in Indonesia, but he has also made wholly unexpected discoveries of far-reaching importance to the student of human nature and for the interpretation of the history of civilisation of the whole world.

With quite exceptional skill and insight he has been able to discover a pathway through the amazing jungle of Indonesian customs and beliefs, and to arrive at certain general conclusions which are of fundamental importance.

The most striking of these generalisations is the recognition of the fact that the irregular distribution of megalithic monuments is explained by their association with the localities where ancient gold-mines or pearl beds are found. This discovery made it plain that it was the search for special forms of wealth which attracted ancient miners and pearl-divers to certain places, and not to others, in Indonesia (and throughout the world). These immigrants introduced a distinctive group of customs and beliefs wherever they settled—not merely peculiar methods of burial, but also terraced cultivation and irrigation, a system of chieftainship and a priesthood, the belief in a sky-heaven, habits of warfare and head-hunting, and a host of other peculiar practices which will enable the investigator to determine whence the wanderers came and the dates of the diffusions of culture of which they were the bearers.

But the magnitude of Mr. Perry's achievement is not to be measured merely by his demonstration of the motives which prompted the spreading abroad of the elements of civilisation twenty-five centuries ago and his explanation of the geographical distribution of certain phases of culture. The searching analysis in his book reveals the fact that before the coming of the stone-using people the indigenous population of Indonesia was leading an unexpectedly simple and idyllic life of peace and contentment singularly free from any display of inventiveness. It sheds a new light upon the factors which determine material and intellectual progress and upon the meaning of civilisation.

The work of Dr. Rivers and Mr. Perry is transforming ethnology from an incoherent jumble of fairy tales into a real science.

G. ELLIOT SMITH.

WAR WORK OF THE BRITISH MEDICAL SERVICES.

British Medicine in the War, 1914–17. Being Essays on Problems of Medicine, Surgery, and Pathology arising among the British Armed Forces engaged in this War, and the Manner of their Solution. Collected out of the *British Medical Journal,* April–October, 1917. (London: British Medical Association, 1917.) Price *2s. 6d.*

THIS reprint of collected papers from the *British Medical Journal* is of very great interest, demonstrating as it does the rapid progress made in the medical services of the Navy and Army during the war. Although the articles were published at various dates between April and October, 1917, the methods described in some instances prove less than a year later to be only of historical interest: conditions and disease problems are discussed which are no longer confronting the armies in the field. The editor's preface eloquently directs the reader's attention to these points, so that we never lose sight of the view that medicine and surgery in this war are not, and cannot be allowed to become, stationary. Used as a guide and handbook of practice in the field, this collection of articles would soon be found out of date, but, carefully read, one can trace clearly the landmarks on the road that has been traversed.

The medical departments of the Navy and Army have, fortunately, been characterised by broad-minded elasticity. Innovations have been welcomed and powers of adaptation displayed by the authorities which had scarcely been anticipated. This volume contains many articles which demonstrate the encouragement given to new ideas and new methods. A public which was shocked by the revelations from Mesopotamia will turn with relief and satisfaction to this story of constant improvements in treating wounds and dealing with disease. Perhaps barely sufficient justice is done to the administrative officers of the medical services, upon whom falls the ultimate burden of almost daily reorganisation in order to give effect to improvements and discoveries brought under their notice.

The remodelling of casualty clearing stations into first-rate surgical units is an outstanding example of the revolutions necessary and possible during the war. An admirable description of this development is given in chap. vi. ("The Development of British Surgery at the Front") by Major-Gens. Sir A. Bowlby and C. Wallace.

In chap. v. ("Medicine and the Sea Affair") graphic accounts are given of how the sick and wounded are handled in the Navy. The illustrations in this chapter are particularly good, and help the reader to appreciate a side of the war which few have seen. Fleet-Surgeon R. C. Munday, R.N., has contributed a most readable paper on hygiene, dealing, *inter alia*, with that most difficult problem, the ventilation of warships.

Chap. iv. ("Bio-chemistry and War Problems") lifts for us a corner of the curtain, revealing a wonderland of science and infinite fields of experiment and research beyond. Dr. H. D. Dakin can only touch on the fringe of his subject, but on all sides it is admitted that through bio-chemistry lies the road to further progress. In no branch of warfare have chemists, physicists, and physiologists played a more valuable part than in that connected with poisonous gases. At present, for obvious reasons, "Gas Warfare" cannot be discussed in detail. Hence the very high grade of scientific work that is being done in this direction must of necessity be almost unknown to the public.

Chap. viii. ("Military Orthopædic Hospitals"), by Dr. W. Colin Mackenzie, reminds us of one of the principal needs of the wounded soldier. Brilliant operations at the front which save lives and limbs are invested with a glamour of their own. There is, however, an immense branch of surgery carried on out of the limelight which is worthy of the increasing attention it is now receiving.

The name "orthopædic" is unfortunate in itself. Few medical readers and fewer still amongst non-medical readers realise all that the term implies. Briefly, "orthopædic surgery" includes every possible operative and other device which is designed to restore function in injured parts. This chapter is well worth reading, none the less so because the history of orthopædic surgery is the history of a branch of surgery entirely British in its origin. The importance of "orthopædics" will continue long after the war, when "war-surgery," properly so-called, is being forgotten without regrets.

Chap. xiii. ("The Part Played by British Medical Women in the War") may be remarkable to some readers who have not had the opportunity of witnessing at first hand the increasing importance of women in medicine and surgery. Gradually, as it becomes obvious that a man's proper place is in the fighting line, the anomaly of a woman taking charge of the sick and wounded is, in fact, less striking than the anomaly of a man occupied thus instead of in fighting. The chapter on the R.A.M.C. and its work (including a short paper on the Canadian Army Medical Service) is graphically written and well illustrated. With the increase in air activity, and especially since the bombing of medical units and hospitals seems to have become an integral part in the German art of war, the illustrations and descriptions already require modification in many details.

One outstanding omission there is in this volume—namely, the dental services. The dental services of the C.A.M.C. are shortly described, and their immense value in saving sick wastage rightly insisted upon. Is all mention of the R.A.M.C. dental services omitted because they have not been developed and their potentialities recognised?

OUR BOOKSHELF.

Wireless Telegraphy and Telephony: A Handbook of Formulae, Data, and Information. By Dr. W. H. Eccles. Second edition, revised and enlarged. Pp. xxiv+514. (London: Benn Bros., Ltd., 1918.) Price 22s.

THIS book is written mainly for the technical expert, but the amateur who dips into it will find much to interest him. The theories hitherto advanced to explain the transmission of "wireless" signals are by no means complete, and some of them are very far from convincing. It is satisfactory, therefore, to notice that the author adopts generally a neutral attitude. In few industries is there greater scope for theoretical speculation, or a more crying need for it. The operator listening to the mysterious sounds sometimes heard in the telephone of his receiving apparatus, due often to cosmical influences, has every incitement to find out their causes.

In the second edition of his book the author has made some interesting additions. We have noticed descriptions of Heyland's alternator, of the oscillion telephone and telegraph transmitter for aeroplanes, and of the Darien system of the United States Navy. The author acknowledges his debt to the Proceedings of the American Institute of Radio Engineers, to which society practically every wireless expert belongs. We have also noticed an interesting account of the upper atmosphere. A useful glossary of technical terms is included. We learn, for example, that "radiophare" is a radio-telegraphic lighthouse which aids navigation by emitting characteristic signals. By estimating the bearings of two charted radiophares the navigator can readily determine the position of his ship.

As a heraldic device for his book, or possibly for radio-telegraphy in general, the author had the happy inspiration to choose the graph of two superposed electric waves of different frequencies with the axis vertical. The effect is not altogether unlike that of the rod of Mercury with its intertwined serpents. There are not many misprints. On p. 54, however, the formula for the capacity of an ellipsoid is still given incorrectly—possibly because no one uses it. The u^2 should be u.

Sir William Ramsay as a Scientist and Man. By Prof. T. C. Chaudhuri. With an Introduction by Prof. P. Neogi. Pp. ix+66. (Calcutta and London: Butterworth and Co., 1918.) Price 1.8 rupees net.

THIS little book opens with a short but appreciative account of Sir William Ramsay's early life, education, and career, special attention being directed to his earnest efforts to impress on the Government the importance of scientific education and research and the necessity for co-operation between the Government and the scientific societies in connection with the war.

After a brief reference to Ramsay's early work on organic chemistry, and to his researches on physical and inorganic chemistry, there is a fuller account of the discovery of the inert gases.

The last three chapters are devoted to radioactivity, modern views on electrons and elements, and the question of the transmutation of elements, with especial reference to Ramsay's researches and views.

Readers will obtain a clear idea of the great part played by Sir William Ramsay in the development of chemistry, but the portrait is not well reproduced, and there are a few inaccuracies.

S. Y.

The Practice of Soft Cheesemaking. Fourth revision. By C. W. Walker-Tisdale and T. R. Robinson. Pp. 106. (London: John North, 1918.) Price 3*s.* net.

THE revised edition of this small volume appears at an opportune time, as there is a considerable demand for information as to the best means of utilising small quantities of milk. Full working details concerning the manufacture of soft cheeses are given along with chapters upon the production of clean milk, the preparation of cream, and the packing and marketing of the soft cheese. Those unacquainted with the terms used in dairying will find the explanations given in one of the sections of great help, whilst the regulations of the Board of Agriculture will be found useful for reference purposes.

This handbook can be strongly recommended to anybody who proposes to make soft cheese; and whilst some practical instruction is desirable, the directions are given so clearly and concisely that a beginner need not fear to make a start. The authors also give instructions how to make soft cheese from goats' milk.

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.*]

Substitutes for Platinum.

L'INFORMATION donnée dans *Metall und Erz*, et qui est reproduite dans votre numéro du 15 août, souffre d'une insuffisance de documentation qu'il me paraît utile de relever.

L'alliage nommé "platinite," employé dans les lampes à incandescence, n'est pas né de la guerre; sa découverte a fait partie de l'ensemble des recherches que j'ai effectuées au Bureau international des Poids et Mesures, à partir de l'année 1896, et pour l'exécution desquelles j'ai reçu l'aide la plus dévouée de la Société de Commentry-Fourchambault et Decazeville. Le platinite est entré dans l'usage courant de certaines usines françaises dès l'année 1900, et s'est répandu peu à peu dans les autres pays. Le détail de cet emploi est donné dans mon ouvrage, "Les applications des aciers au nickel," paru en 1904; je ne crois pas exagérer en disant que l'économie de platine réalisée jusqu'ici grâce au platinite dépasse cinquante millions de francs.

C'est également la Société de Commentry-Fourchambault et Decazeville qui a réalisé pour la première fois, dans ses aciéries d'Imphy, les alliages de nickel à fortes additions de chrome; leurs propriétés sont décrites dans l'ouvrage de M. L. Dumas, "Recherches sur les aciers au nickel à haute teneur" (1902); d'intéressantes applications en ont été faites.

Les métallurgistes américains de leur côté fabriquent, depuis quelques années, sur la même donnée, l'alliage "nichrome," dont l'usage s'est beaucoup répandu pour la chauffe électrique des appareils de laboratoire.

CH.-ED. GUILLAUME.

Pavillon de Breteuil, Sèvres (S.-&-O.), 10 septembre 1918.

Future Treatment of German Scientific Men.

I HAVE just read Lord Walsingham's excellent letter in NATURE of September 5, and agree with all he says as to what should be our line of action towards the scientific men of Germany. It is impossible we can meet them just as if nothing had happened since 1914. I quote this sentence (how true it is!):—"It is impossible to dissociate the mental attitude of the population of that country, by no means excepting the highly educated and scientific classes, from the world-conquering aspirations of their rulers, or from the barbarous atrocities committed by them in pursuit of that national ideal."

I have not heard of a single letter from the very large number of the above scientific classes in Germany to acquaintances in this country in which such acts have been denounced, nor have I seen any protest or condemnation of German methods coming from the Germans in our midst, of whom there are many who have enjoyed in this country friendship, hospitality, and even protection, such as no British subject could hope to receive in Germany. Any expressions of this kind would be well known, quoted, and notorious. I think I should have heard of them, although I now lead a very retired country life.

Instead of protecting objects of science and art by leaving them intact for the benefit of other nations and the world in general, the German has raised looting and destruction into a devilish art. Soldiers are trained, and even the officers led by them, to commit useless destruction, combined with every conceivable atrocity on man, woman, and child. It is lamentable to think of the geological and natural-history collections which have been destroyed in Belgium alone—a country famous for its scientific men, the work of their lives gone for ever. I trust all this will not be forgotten when the war is fought out to a proper issue, and that all Lord Walsingham suggests will come about and just punishment be thus meted out.

The German scientific man has been spoilt by success in the past; he was first in the field in many countries, particularly our own. I knew him in days gone by in India, when he filled the best appointments in the Geological Survey, the Forestry Department, etc. Many were friends of my own. In those days they were quite different men in every way from those of to-day, so complete a change has come over the whole German population. It is sincerely to be hoped they will never be employed again in any capacity. H. H. GODWIN-AUSTEN.

Nore, Godalming, September 17.

The South Georgia Whale Fishery.

A NOTE on p. 470 of NATURE for August 15 contains the statement that scientific experts have, until now, not been consulted in the matter of the South Georgia whale fishery, which has been administered entirely by the Colonial Office. There is at present a considerable tendency to criticise Government Departments for failing to make use of scientific opinion, but I feel sure that you will allow me to point out that this particular criticism is not justifiable. The Colonial Office has for some years been fully alive to the fact that the regulation of sub-Antarctic whaling is a scientific problem, and since 1910 it has been in constant communication on the subject with the Natural History Museum. Under arrangements thus made the museum receives detailed statistics from the companies operating at South Georgia, each individual whale caught being separately recorded. Similar statistics are beginning to come in from the South Shetlands (a district almost as important as South Georgia) and from some of the African companies; while promises of returns from other whaling centres have also been received. In addition to this, the Colonial Office furnishes half-yearly and other reports on the whaling operations at the districts under its jurisdiction, and it has received many reports from the museum commenting on the facts thus recorded, and offering advice on the various questions raised.

In the course of 1913 the Colonial Office proposed that a biologist should be sent to South Georgia to make investigations which might contribute towards the solution of the whaling problem. In consultation with the museum, the work was offered to Major G. E. H. Barrett-Hamilton, who accepted the task, and reached South Georgia in November, 1913. News of his untimely death, on January 17, 1914, while strenuously occupied with his observations on whales, was shortly afterwards received in London. The manuscript notes which he left behind show that the investigation had been placed in most competent hands, and they have formed the basis of an important report, which is at present under consideration at the Colonial Office. The appointment of Major Barrett-Hamilton had been made as an initial step in a much larger scheme for the investigation of the problems connected with whaling by means of a scientific station to be established for several years on the Antarctic continent. The preparations for carrying out this idea were interrupted by the war.

That the urgency of the question was recognised by Government Departments, and that the need for obtaining scientific opinion was felt, was further shown by the appointment of an Inter-Departmental Committee on Whaling and the Protection of Whales. In August, 1913, the Colonial Office wrote to the Natural History Museum asking for information with regard to the scientific aspects of whaling for the use of this Committee, and a memorandum on the subject was submitted by the museum in due course. The Committee was engaged in hearing evidence during the first half of 1914, but its labours were discontinued on the outbreak of war.

Early in the present year a new Committee was appointed to facilitate prompt action at the conclusion of the war in regard to the preservation of the whaling industry in the Dependencies of the Falkland Islands. This Committee, on which the Natural History Museum is represented, is actively engaged in collecting information, under the auspices of the Colonial Office.

It is sometimes assumed that expert scientific advice is capable of settling any difficult question which may arise within its own province. The solution of the problem of protecting whales is, however, no easy matter; and I doubt whether there is at present unanimity on the subject among scientific experts. The trustees of the British Museum have for some years been convinced of its importance and urgency, and they have welcomed the opportunities afforded them by the Colonial Office of expressing their views and tendering their advice, based on the study which has been given to the subject in the museum. Assistance from those competent to give it would be cordially received, and I am glad to have this opportunity of inviting scientific experts to communicate their views on the protection of whales to the Natural History Museum, and thus to assist in a matter which is not only of great zoological interest, but also one which may be described without exaggeration as of supreme national importance. SIDNEY F. HARMER.

British Museum (Natural History),
Cromwell Road, S.W.7.

Vitality of Gorse-seed.

ASSERTIONS regarding the length of vitality of certain seeds are frequently made, but these, when investigated, often lack proof. Hence it may be worth while to put on record a clear case of the seeds of the gorse (*Ulex europaeus*) retaining their germinating power for twenty-five years.

Some forty acres of gorse- and heather-covered land situated near my home in the plain of Cumberland were drained, cleaned, and ploughed out in 1893. This area was kept in arable rotation for a number of years; then part of it was laid down in grass in 1904, and the remainder in 1906. It soon became evident that this new pasture would rapidly revert to a gorse-covered common unless drastic measures were taken to rid the ground of the numerous gorse seedlings, which had sprung up from the seeds brought to the surface by the last ploughing. These were stubbed out, and in two or three years' time the ground was entirely free of gorse plants, and has continued so for the ten or more years it has been allowed to remain in permanent pasture.

Last winter this land was again brought under the plough by order of the local War Agricultural Committee, and was sown with oats. The crop has now been reaped, and gorse seedlings, 6 in. or more in height, are to be seen scattered over the stubble, being especially abundant where originally the gorse grew strongest. Evidently, then, the last ploughing has brought to the surface a fresh lot of seed which, though having lain buried in the soil for a quarter of a century, has retained its germinating capacity.

JOHN PARKIN.

The Gill, Brayton, Cumberland,
September 9

Rock-disintegration by Salts.

THE reference in NATURE for September 19, p. 50, to Mr. J. T. Jutson's paper dealing with the influence of the crystallisation of soluble salts in promoting the weathering of rocks reminds me of Il Fungo, an isolated mushroom-shaped rock opposite Lacco Almeno, on the north shore of Ischia. Formed of porous volcanic tuff, the sea-water rapidly ascends by capillarity, and, being evaporated, large crystals of salt are produced on the face of the rock. As these natural processes are most active over an area about midway between the sea and the summit, the sides there are being hollowed out very rapidly, large flakes of rock constantly falling.

In 1892 the late Dr. Johnston-Lavis gave me a photograph of, and much valuable information respecting, this rock. C. CARUS-WILSON.

September 20.

GERMAN INDUSTRY AND THE WAR.

I.

A RECENT issue of the Bulletin de la Société d'Encouragement pour l'Industrie Nationale[1] —the French counterpart of our Journal of the Society of Arts—contains two interesting and important articles on the present and future influence of the war on German industry, written by MM. Jaureguy, Froment, and Stephen, which make known a number of facts concerning the means by which Germany has attempted, with more or less success, to evade efforts to isolate her during the war. In spite of the rigour of the blockade to which she has been subjected, there can be little doubt that, thanks to the knowledge, skill, and ingenuity of her chemists and engineers, encouraged and aided financially by the State, she has hitherto managed to provide herself with the means of carrying on the war—not only as regards munitions, in which she has been eminently successful, but also in regard to the alimentation of her people, in which, of course, owing to the complexity of the problem and to natural conditions beyond her control, her success has been less conspicuous. The new industries which have been created, and the great development of those already in existence, would, apparently, enable Germany to prosecute the war almost indefinitely. The determining factors will be the exhaustion of her man-power and the gradual weakening of her *moral*. Both these causes are beginning to tell, and it is abundantly evident from a variety of signs that the Higher Command is realising that the rot has set in. Junkerdom is now fighting only for its existence. The steady and persistent pressure of the Allies will accelerate the advent of the inevitable *débâcle*. The end will come when the remnants of the German armies are driven back to the Rhine.

In the meantime it is instructive to note what Germany is doing in her efforts to stave off the disaster which assuredly awaits her. It is always wise to learn from your enemies when you can, and Germany has much to teach us concerning the manner in which Science may be made subservient to War and to the conditions which war produces.

We have already dwelt, on former occasions, on the importance of the nitrogen problem in the war, and have given some account, in the light of such information as was available, of the methods by which Germany has attempted to solve it. The communication before us contains a number of statistical statements respecting the development and present position of the several synthetic processes of utilising atmospheric nitrogen which are of interest at this present juncture. It appears that the Birkeland-Eyde process, which in 1913 furnished Germany with some 5000 tons of calcium nitrate from the Norwegian factories, is still worked to a limited extent in Saxony, where a manufactory was established before the war at Muldenstein, employing lignite as a source of power. Ostwald's process of oxidising ammonia catalytically—or rather the Frank-Caro modification of it—is in operation at Spandau, Höchst, Griesheim, and at works belonging to the Badische Aniline Company. Kayser, at Spandau, employs apparatus capable of oxidising 370 kilos. of ammonia in twenty-four hours with a yield of from 90 to 95 per cent. The Badische Company makes use of plant constructed by the Berlin-Anhaltische Maschinenbau, oxidising about 750 kilos. of ammonia in twenty-four hours. The heat furnished by the reaction suffices to maintain the catalyser at a constant temperature of 700° C. The main catalytic agent is said to be one of the oxides of the iron group containing bismuth or one of its salts. During 1915 some thirty installations of this system were erected, each capable of oxidising more than 12 million kilos. of ammonia annually. In the more recent forms of the apparatus the yield has been increased to 17 million kilos. Before the war the main source of supply of ammonia was from coke-ovens and from the gasworks, which in the aggregate furnished about 500,000 tons of sulphate of ammonia, of which agriculture absorbed 450,000 tons.

The Haber process of combining nitrogen, obtained by the fractional distillation of liquid air, with hydrogen procured by the electrolysis of water, as worked out by Bosch and Mittasch, chemists of the Badische Company, was already in operation before the war, but has now been greatly extended. The factory at Oppau has been much enlarged at the Government expense, and other factories have been erected. The capital of the Badische Company has been increased from 14 to 90 million marks. The firms of Bayer, Meister Lucius, Casella, Weiler-Ter-meer, Kalle, and the Griesheim-Elektron Company have also augmented their capital, and are work-

[1] Bulletin de la Société d'Encouragement pour l'Industrie Nationale, (Paris, 1918.)

ing in a consortium representing a capital of upwards of 1 milliard of marks.

In addition to the Haber process, ammonia is being produced by the cyanamide method. The factories employing this process are mainly erected in the neighbourhood of lignite deposits, in localities furnishing supplies of natural gas, or where hydraulic power is available. Before the war the principal factories were the Bayerische Stickstoffwerke at Trostberg, the A.G. für Stickstoffdünger at Knapsack, and the Mitteldeutsche Stickstoffwerke at Gross-Kayna (Geiseltal). The development of the cyanamide industry is encouraged by the Government. The Bavarian Company received a subsidy of 40 million marks and undertook the erection of two large factories in proximity to deposits of coal and lignite. These were completed towards the end of November, 1915. The net profits of the Bayerische Stickstoffwerke in 1914-15 were 653,185 marks; in 1916-17 they were 1,547,261 marks. In 1915 the company at Knapsack raised its capital from 3 to 8 million marks. In 1916 the total production of cyanamide had increased to 400,000 tons, practically a hundred times greater than it was in 1913. There is no doubt that it has since been considerably augmented.

Such are the means by which Germany has meanwhile rendered herself independent of Chile saltpetre, or, indeed, of any outside source of nitric acid or ammonia, and has provided herself with one of the essential munitions of war. So absolutely necessary is the production of nitric acid that, in its absence, no army could hold together for a week under modern conditions. This enormous development of the synthetic production of ammonia and nitric acid is of great economic interest, and is bound to have a profound effect on industry after the war. The economic aspect of the matter, however, does not now concern us. We may return to its consideration on another occasion.

Scarcely less important, in view of the war, is the problem of sulphur and sulphuric acid, to which we have already directed attention. Our blockade practically suppressed all German importation of pyrites, of which in time of peace she received upwards of 10 million quintals, $8\frac{1}{2}$ millions coming from Spain. Germany was thus restricted to her own poor deposits in Thuringia, in the Lahn basin, at Tessenberg in Bavaria, and at Meggen in Westphalia. The important deposits of cupreous pyrites of Styria and Hungary were at once exploited, as were those of sulphur in Anatolia. The roasting of blende at Vieille-Montagne and in Silesia had already furnished considerable quantities of sulphuric acid before the war: by intensive working the yield was considerably increased. Processes like those of Schaffner and Helbig and of Chance and Claus were worked on a large scale. The Badische Company utilised the method of Walther Feld, in which crude coal-gas is made to yield its ammonia and sulphur in the form of ammonium sulphate. This is effected by agitating the gas with a solution of ammonium tetrathionate, which absorbs the hydrogen sulphide and ammonia, giving ammonium sulphate, hyposulphite, and free sulphur. By boiling the ammonium tetrathionate with the hyposulphite, ammonium sulphate, sulphurous acid, and sulphur are obtained. By making the two last-named substances react upon the hyposulphite arising from the purification, the tetrathionate is regenerated. The Badische Company has also attempted to prepare sulphuric acid from gypsum or anhydrite, of which Germany has considerable deposits, by roasting the gypsum either alone or mixed with coke, whereby it is transformed into calcium sulphide, which can then be treated by any of the established sulphur-recovery processes, or converted into lime or sulphurous acid, to be either utilised in the manufacture of wood-pulp for paper-making or transformed into oil of vitriol.

So important is sulphuric acid for the purposes of war that its production is controlled by a War Committee, and the Society for the Production of War Chemicals has created a special section known as the Department of the Administration of Sulphur. As in the case of other chemical products, the manufacture and sale are regulated, and fixed prices have been legalised.

In a subsequent article we propose to show how Germany has dealt with the problems of combustibles, metals, alcohol, oils, fats, soap and glycerin, textiles, wood and wood-pulp, caoutchouc, turpentine and lubricants, food, fodder and manures—all of which are more or less essential to her, and of which she has been largely deprived by her own action in embarking upon a war which will prove her ruin.

MEDICAL EDUCATION IN ENGLAND.[1]

THE issue of the modestly named paper before us marks a new stage in the relation of the State to English education. In no merely official style, but with the breadth and freshness of outlook proper to a prophet of reform, Sir George Newman reviews the "undone vast" in the training of medical practitioners for national service. He gives due credit to the great achievements of English medicine, as they have been wrought out by private enterprise, for until comparatively late years the schools of medical craftsmanship were in their essence proprietary, and their system was but a modified apprenticeship. In Scotland doctors were trained at the universities and caught something of the university spirit. The last generation has seen a change, in provincial England at least: London is still in the stage of painful emergence. When grants to the medical schools were first made by the Board of Education in 1908, the State necessarily assumed the duty of watching their application to productive uses. A universities branch of the Board was formed, and Sir George Newman became its medical

[1] "Some Notes on Medical Education in England." A Memorandum addressed to the President of the Board of Education by Sir George Newman, K.C.B., Chief Medical Officer, Principal Assistant Secretary of the Board of Education, etc. Presented to both Houses of Parliament by command of His Majesty. (Cd. 9124.) (London: Stationery Office, 1918. Price 9d.)

assessor. His admirable contribution to "Reconstruction" is the fruit of his official surveys of the present state and future needs of the English schools.

The relation of the community to the doctor has altered. The latter is no longer merely a private craftsman dealing with private clients. Before the war called the main body of practitioners into war service, the State as such claimed the whole-time or part-time service of some 20,000 of them, and imposed heavy civic responsibilities upon the rest. The doctors were called to a wider ministry than heretofore; the State by implication must needs concern itself with the question of seeing that they were fitted to serve it. In the words of the paper, "medicine has become a quasi-public profession; . . . the citizen, as legislator and as taxpayer no less than as patient, is interested in the maintenance of a high standard of medical education. . . . The commonwealth does not require two standards of medical man. . . . All medical education should be fundamentally one and the same in regard to basis, technique, and spirit." Sir George Newman without hesitation pronounces that there is only one education which will meet the requirements of the nation; "in a word, it is a university education in medicine. And the foundation of such an education is science."

He is well aware that the present five years' curriculum is overloaded; but it can be lightened to some extent when all secondary schools teach science efficiently. The student would not, as now, begin his medical course ignorant of the essential propædeutic of chemistry, physics, and biology. If the elements of these were already familiar to him, the university professors of the first-year stage might limit themselves to senior courses on the medical bearings of these subjects. Anatomy and physiology, now taught to an ever-increasing degree in the true scientific spirit, should be more closely related with clinical medicine and surgery. The laboratory and the demonstration-lecture must displace the "systematic" lecture. Pharmacology, from which "materia medica" and pharmacy may now be severed, should link up physiology with clinical therapeutics, and have its laboratories and special staffs. Therapeutics should constitute a distinct department, in direct relation with the hospital ward and out-patient room. Pathology, which has of late "come to its own," must all over the country have its hospital "institute," under its own professor and assistants, and be worked as an indispensable factor in ward-work, and planned on the basis of "cases" rather than "specimens."

It is in the clinical subjects and in preventive medicine that English schools are most defective. The English system treats medicine too much as an art, too little as a science. It gives small chance for the study of prophylaxis or of incipient disease; its ward-cases are too often the "finished article." It is ill organised, for its professors are part-time men, whose bread-winning work is private practice, not their teaching. As an eminent physician has said: "Harley Street is the grave of the clinical teacher." "A man cannot serve two masters," says Sir George Newman. "That is the predicament of the clinical teacher in England. And there is only one solution. *He must be paid as a teacher.*" This means, as has been pointed out authoritatively by many who have a right to speak, the establishment and endowment of whole-time professors of the "final" subjects, medicine, surgery, and obstetrics, each with his "unit" of wards, laboratories, and staff, co-ordinated, freed from the compulsion of outside practice, bound to devote himself not only to teaching, but also to research. "The need of English medicine above all others at the present time is the opportunity for the cultivation of the laboratory method and the scientific spirit." For preventive medicine the like is required; the ordinary practitioner need not be a professional or specialist medical officer of health, but he must know enough to articulate his own work with the State services that touch it at innumerable points; and he must interfuse prevention with all his curing. Hence, in his training, it is the interest of the nation to ensure that the purpose and spirit of preventive medicine should pervade the entire curriculum—for all the branches and departments of the latter need its inspiration. The General Medical Council last May took the first step along this path of progress.

"The Place of Research in Medical Schools" is the subject of a moving chapter, in which the verdict of the London University Commission (1913) is cited as an aphorism: "It is a necessary condition of the work of university teachers that they should be systematically engaged in original work," with the pithy comment that "he only is the great teacher who is inspired by the spirit of discovery."

The urgent need for organised and efficient "post-graduate" instruction, to enable the practitioner to supplement his general knowledge by specialities, and to keep himself abreast, by periodic study at the fountain-heads, of modern advances, is eloquently expounded, not for the first time. But it has been brought home with new insistence by the pressure of recent experience. The men of the medical services—Army, Navy, Indian, Colonial—clamour for such opportunities; graduates from the Overseas Dominions, from the United States, and from the Allied countries, are asking for the chance to study in Britain rather than in Germany or Austria. Are we ready for them in London, in England? Sir George Newman sets forth what is still lacking in our equipment, and the list of shortcomings is not small. The cost in money will be considerable: we have the men; we require the organisation. But the President of the Board of Education and "both Houses of Parliament" are told frankly that "it would handsomely repay the State to encourage and to aid" a regular system of post-graduate study, "so rapid and profound are the advances in medicine."

In his conclusions the author finds that, for remedial action, two fundamental necessities exist. There is the need for further financial assistance; there is the need for guidance and direction. The first implies substantial aid from the State; for the second, trust is placed in "the predominant authority of the university . . . as against the claim of proprietary interest," the State assuming only the functions of supervision and advice, "with due regard to the freedom of the university." How far such "due regard" can persist side by side with subvention and supervision it is not easy to say. But if departments and officials were endowed with Sir George Newman's knowledge, and imbued with his temper of sweet reasonableness, a way would be found of reconciling the bureaucratic and the academic points of view. That a way must be found for advance, along the lines of his vividly clear and deeply wise survey, is certain, unless England is, in the Reconstruction, to lose her opportunity and miss the lessons of her time of trial and testing.

THE DYNAMICS OF CYCLONIC DEPRESSIONS.[1]

THE publication in 1906 of Shaw and Lempfert's "Life-History of Surface Air-Currents" marked the passing of a milestone in the progress of our knowledge concerning the mechanism of travelling cyclonic depressions, and it is a matter of surprise that so little further advance along the same lines has been made since that time. This lack of progress obviously could not continue for ever, and two recent publications by Sir Napier Shaw suggest that the next milestone has now been passed.

In the earlier of the two papers[2] a travelling rotating disc of air was considered in which all the air particles had the same relative tangential velocity around the centre. This hypothesis led to valuable conclusions concerning the "secondaries" which so frequently form upon the southern side of the centre, but did not throw much light upon the cyclone as a whole. On consideration it became evident that the mathematics would be much more manageable if the disc of air were assumed to have uniform vorticity ζ, so that the relative velocity $v=\zeta.r$, and, working on this assumption, valuable results have been obtained. This hypothesis implies a disc of air revolving about its centre as a solid like a cartwheel, and the "normal cyclone" considered in the present paper has within itself a circulation of this type. The air particles will trace out trochoids formed by the rolling of the disc of relative motion along the line of motion of the instantaneous centre, and, if sufficiently extended in all directions, the mass will possess intrinsically two centres, (1) a centre of instantaneous motion, or *kinematic centre*, about which the resultant winds shown upon the map at any instant will be revolving (surface incurvature being neglected), and (2) a centre of revolving fluid or *tornado centre*—that is, the centre of the "cartwheel"—which is found at a distance V/ζ on the right-hand side of the path of the instantaneous centre, where V is the velocity of travel of the depression as a whole.

The "normal cyclone" has, however, yet a third centre. If upon the pressure field of a stationary circular depression a uniform pressure gradient from N. (high) to S. (low) be superposed, it is shown that every air particle will commence to follow its appropriate trochoid curve, and the effect will be that the depression will advance across the map from W. to E. with a speed V, while at the same time the system of isobars will be displaced a distance $V/(2\omega.\sin\phi+\zeta)$ to the south from the centre of instantaneous motion (ω equals angular velocity of the earth, ϕ equals latitude). This centre of isobars is termed the *dynamic centre*, and forms the third centre of the travelling depression. As a numerical example, if the rotation of the disc be such that a velocity of 20 m./sec. (gale force) is found 200 km. from the centre of instantaneous motion, and if the eastward speed of progression of the depression be 10 m./sec. in our latitude, the tornado centre will be 100 km., and the dynamic centre 45 km., to the south of the instantaneous or kinematic centre.

Viewed in another way, the pressure system may be taken to be compounded of a set of circular isobars round the tornado or "cartwheel" centre, and a uniform pressure gradient from S. to N., when the rate of advance V of the depression will equal the geostrophic wind corresponding with this field. Since this superposed field may reasonably be taken to be the same as the general field surrounding an isolated cyclonic depression, the conclusion is reached that the speed of progression of such a depression will depend directly upon the strength of the surrounding field, and in certain examples shown this is satisfactorily confirmed. One of the most interesting results reached is undoubtedly that the winds shown on a map for an eastward moving depression will circulate, not about the isobaric centre, but about a point to the north which may be of the order of 50 km. distant. Practical examples of this are also adduced. Other conclusions of importance, such as the probability of secondaries developing at the tornado centre, cannot be more than alluded to in a short notice like the present. The demonstration of the fact that a normal travelling cyclonic depression has three distinct "centres" is the outstanding feature of the paper.

To the reader the treatment appears a little disjointed and to lack mathematical sequence, but the author has forestalled criticism on this point by explaining that he considered it better to set out the matter in the order in which it was developed, since this method would bring directly under review the various aspects of the subject that are presented to the student of weather maps. A straightforward theoretical discussion would lack this advantage.

J. S. D.

[1] "The Travel of Circular Depressions and Tornadoes and the Relation of Pressure to Wind for Circular Isobars." By Sir Napier Shaw. Meteorological Office. Geophysical Memoirs, No. 12, 1918.

[2] "Revolving Fluid in the Atmosphere." Proc. Roy. Soc., A, vol. xciv., p. 34, 1917.

NOTES.

We are glad to be able to announce that Stonehenge has been offered to the nation, and accepted on behalf of the Government by the First Commissioner of Works. The munificent donor is Mr. C. H. E. Chubb, of Salisbury, who bought Stonehenge in 1915. For the duration of the war the income of the property is to be handed to the British Red Cross Society.

THE following Food Council to consider general questions of policy affecting the administration of the Ministry of Food has been constituted:—The Rt. Hon. J. R. Clynes (Food Controller), chairman; Major the Hon. Waldorf Astor (Parliamentary Secretary to the Ministry of Food), deputy-chairman; Sir Alan Anderson, K.B.E., vice-chairman; Sir J. F. Beale, K.B.E. (First Secretary to the Ministry of Food); Mr. W. H. Beveridge (Second Secretary to the Ministry of Food); Mr. W. H. Peat; Capt. S. G. Tallents; and Mr. E. F. Wise. Mr. F. L. Turner will act as secretary. The following special Boards in connection with the Council are being constituted:—Imports Board, Home Supplies Board, and Joint Finance Board.

NOTICE has been given that summer time will cease and normal time be restored at 3 a.m. (summer time) in the morning of Monday next, September 30, when the clock will be put back to 2 a.m. The hour 2–3 a.m. summer time will thus be followed by the hour 2–3 a.m. Greenwich time.

DR. W. W. CAMPBELL, the director of the Lick Observatory, of the University of California, has been elected a correspondant of the Institute of France in the section of astronomy.

THE Montyon prize of the Paris Académie des Sciences, of the value of 100*l*., has been awarded to Drs. H. Guillemard and A. Labat for their researches on asphyxiating gases

THE annual Thomas Hawksley lecture of the Institution of Mechanical Engineers will be delivered in the hall of the Institution of Civil Engineers on Friday, October 4, by Dr. W. C. Unwin, who will take as his subject "The Experimental Study of the Mechanical Properties of Materials."

AN address on "Commerce and Industry after the War" will be given, under the auspices of the Industrial Reconstruction Council, by Sir Albert Stanley, President of the Board of Trade, on Wednesday, October 2, at 4.30, in the Saddlers' Hall, Cheapside, tickets of admission to which can be obtained from [illegible] and 4 Tudor Street, E.C.4. At the recent annual meeting of the Council the following new members were elected to the executive committee:—Sir C. McLeod, Miss L. Dawson, Mr. G. Selby, Mr. J. Baker, Mr. T. O. Jacobsen, Miss M. F. Peake, Mr. E. W. Mundy, and Lieut. H. V. Roe.

THE Meteorological Office has given notice that it will not issue further copies of the Daily Weather Report, the Weekly Weather Report, and the Monthly Weather Report during the war. Subscribers and others are notified that, by arrangement with the director, copies can be retained for them and delivered after the war. Observations will be made as hitherto, and doubtless all the reports will be promptly prepared and printed, but they are no longer available except for public service, where all meteorological information is at present of the highest val[illegible]

A MONUMENT in bronze has been [illegible]ted to Oswaldo [illegible] at Rio de Janeiro. It represents [illegible] in a sitting [illegible] and bears the following inscription:—"A Oswaldo Cruz, Homenagem do pessoal da Directoria Geral de Saude Publica, 23-III-1903—19-VIII-1909," the dates marking the period of his most productive work, the eradication of yellow fever from Rio.

IN accordance with the decision arrived at at the extraordinary general meeting of the Institute of Chemistry held on April 27, local sections are now being formed in various important centres. The inaugural meeting of the Liverpool and North-Western section of the institute was held on Thursday, September 12. The registrar, who was in attendance by the direction of the council, referred to the objects to be attained by the establishment of local sections. It is anticipated that local sections will be inaugurated during the coming session at Manchester, Birmingham, Edinburgh, Glasgow, Gretna, and probably other centres.

THE twenty-second annual autumn foray of the British Mycological Society was held, in conjunction with the Yorkshire Naturalists' Union, at Selby from September 9 to 14, under the presidency of the Very Rev. Dr. David Paul. On September 9 Dr. Harold Wager delivered a popular address on fungi. On September 11 Dr. Paul gave his presidential address on "The Earlier Study of Fungi in Britain," dealing with mycological work up to the time of Berkeley. Other papers contributed during the week were two by Dr. Wager on "Spore Coloration in the Fungi" and on "A Fluorescent Colouring Matter from *Leptonia incana*"; "New or Rare British Parasitic Fungi," by Mr. A. D. Cotton; and "Observations on some Sand-dune Fungi," by Mr. H. J. Wheldon. At the general business meeting the officers for the ensuing year were elected as follows:—President, Dr. Harold Wager; vice-president, Miss G. Lister; general secretary and editor, Mr. C. Rea; secretary and recorder, Miss E. M. Wakefield; treasurer and foray secretary, Mr. A. A. Pearson. These, with the following elected members, Mr. W. N. Cheesman, Dr. B. Elliot, Prof. M. C. Potter, and Miss A. Lorrain Smith, will form a council for the general management of the society.

WE learn from *Science* that news has been received by Prof. R. F. Griggs, director of the Katmai expeditions of the U.S. National Geographic Society, announcing the termination and giving particulars of the work of this year's field party, composed of Messrs. J. Sayre and P. R. Hagelbarger, in the Valley of Ten Thousand Smokes. The topographic survey begun last year was extended to the shore of the Bering Sea, adding some 1500 square miles to the map, and completing a section across the base of the Alaska Peninsula from Katmai Bay to Naknek. This survey will furnish the data for the construction of a topographic map on the scale of 1/250,000 of the same standard of accuracy as the work of the United States Geological Survey on maps of this scale.

A BI-MONTHLY periodical entitled the *Journal of General Physiology* is about to be started by the Rockefeller Institute for Medical Research, New York. It will be edited by Dr. Jacques Loeb and Prof. W. J. V. Osterhout. Its aim is to serve as an organ of publication for papers devoted to the investigation of life-processes from a physico-chemical viewpoint.

IT has been decided to found a medical journal in Mexico for the publication of contributions by Mexican physicians and surgeons and information concerning the progress of the medical sciences in other parts of the world. Dr. F. Bello, of Puebla, has been appointed editor.

WE note with regret that the name of Capt. H. A. Renwick has been added to the growing list of young men who have sacrificed their lives in the development of experimental aerodynamics. Capt. Renwick was killed in a flying accident on August 19. After having been a student of Pembroke, and taking Seconds in the Mechanical Science Tripos, he entered Messrs. Yarrow's as an apprentice. In the first month of the war Capt. Renwick was gazetted to a pioneer battalion of the South Wales Borderers, and served for some time in France. Having been severely wounded, he was, early in 1916, attached to the Royal Aircraft Factory. Here he found a congenial opening for his scientific powers, and was soon placed in charge of the instruments and apparatus used in experimental flights. Then, as chief of the corps of observers engaged in aero-dynamical experiments in the air, he was closely associated with all the full-scale work carried out at Farnborough, and made valuable contributions to this rapidly developing science. He learned to fly, and made a number of solo experimental flights. Capt. Renwick was a keen and enthusiastic observer, and his incidental observations of physical and meteorological conditions in the air constitute additions of permanent value to the data now being collected towards a fuller knowledge of the physics of the atmosphere.

AN appreciative obituary notice of the late Prof. G. Archibald Clarke, who died on April 27 last, appears in *Science* for August 30. We are glad to see that full justice has been done to his memory in regard to his work as secretary of the International Fur Seal Commission, the findings and policy of which he profoundly influenced. Prof. Clarke was a man who possessed the faculty to an unusual degree of seizing upon essentials and of taking wide views. Hence, as a consequence of his numerous visits to the Pribiloffs on the work of the Commission, he brought together an immense store of facts in regard to the life-history of the fur seal which will form a lasting monument to his memory. Careful of the smallest detail in regard to every aspect of this subject, he ever kept before him the fact that his observations were also to be used by those who had a purely commercial interest in these herds and their preservation. During 1912-13 he carried on investigations designed to extend over a period of four or five years for the purpose of arriving at data as to the rate of increase of such herds, then apparently rapidly diminishing. But, unfortunately, changes in method and *personnel* since 1913 have made this ideal well-nigh hopeless. Fortunately, Prof. Clarke has left a fine record of his many-sided studies of the fur seal problem in numerous memoirs and articles published in *Science* and other scientific and popular magazines. In his capacity as academic secretary to Stanford University he displayed business talent of a high order; hence his services to the University during its early years of existence cannot be overestimated.

THE March part of the *Museum Journal* of the University of Philadelphia (vol. ix., No. 1, 1918) is entirely devoted to the study of American art, the native production untouched by outside influences. We know little about the mythology of the Mayas represented in their painting, sculpture, and other decorative arts, but a faint notion of some of its traits, if not of its contents, may be gathered from the folk tales still current in remote districts of Central America. As leading examples of this indigenous art, Mr. G. B. Gordon describes a remarkable piece of sculpture entitled "A King in all his glory," from the ancient city of Copan, in Honduras, and one of "The Captives," found a few years ago on the Usumacinta River. While in motif and method these carvings will look strange to artists trained under European traditions, they display a remarkable power of characterisation and execution, which are well illustrated by Mr. Gordon's interpretation. Other noteworthy specimens of local American art described in this pamphlet are a fine Maya vase, a pair of fine totem-poles, and beautiful examples of Huron quill-work and of the decorative arts of the Indians of the Amazon.

THE report for the year 1917 of the Museums of the Brooklyn Institute of Arts and Sciences contains some striking figures in regard to the attendance of children, for whom, as in all the American museums, special rooms and collections are set apart. During the year 6226 school-children, with 239 teachers, visited the museum for special instruction. "One thousand four hundred and fifty-six boys and girls of high-school age consulted scientific and literary b[illegible] and periodicals, and prepared for debates." The juvenile visitors and students are catered for by a special staff, and there can be no doubt that extremely valuable educational work is achieved by this branch of the museum's activities.

THE Corporation of Hull has formed a special museum for the illustration of the shipping and fishing industries. An interesting part of the collection is a series of coins and tokens illustrating the evolution of shipping. Typical examples of medieval ships are shown on the seals of Scarborough, Hedon, and many other places. The seventeenth-century tokens, which are so eagerly sought for, show many representations of ships, anchors, etc. The token of Earl Howe (1705) bears on the reverse, "The Wooden Walls of Old England," with a typical example of a fighting ship with tall masts. The collection is described by Mr. T. Sheppard in vol. ii., part 2, of the Transactions of the Yorkshire Numismatic Society.

ALL who are interested in the anatomy of the Cetacea will welcome a memoir on the skull of Cuvier's whale (*Ziphius cavirostris*) which appears in the Bulletin of the American Museum of Natural History (vol. xxxviii., p. 349). The author bases his study on two skulls—one of a young adult female, the other of a ripe fœtus which had been disarticulated. These he describes in detail, and his descriptions will prove of great value to future workers, as well as to those who desire to use his results in comparative work. In the course of his memoir he advances some interesting speculations as to the factors which have brought about the very remarkable changes which have taken place in the morphology of the cetacean skull, and these are worthy of careful consideration.

IN *Sudan Notes and Records* (vol. i., No. 3, July, 1918) a plea is made on behalf of the white ant, which has naturally acquired a bad reputation among European residents. The characteristic feature of the climate of the Sudan is the rapid growth of vegetation promoted by seasonal rains or artificial irrigation, followed by a period of drought and desiccation. The white ant attacks vegetation only when it is weakened by drought or disease, and in that case the sooner it is destroyed the better. But for the activity of the white ant the whole of the fertile parts of the Sudan would, in a very few years, be covered with an impenetrable layer of dead vegetation; and the only alternative method to clear it off would be by the agency of fire, the dangers of which are obvious.

A SECOND edition of vol. v. of "Special Reports on the Mineral Resources of Great Britain," dealing with potash-felspar, phosphate of lime, alum shales, plumbago or graphite, molybdenite, chromite, talc and steatite (soapstone, soap-rock, and potstone), and diatomite, has just been issued by the Ordnance Survey Office, Southampton, and in London by Messrs. T. Fisher Unwin, Ltd. It is mainly a reprint of the first edition, but gives additional information respecting potash-felspars, steatite, and diatomite.

THE *National Geographic Magazine* for June last contains a very fine series of instantaneous photographs illustrating the processes of coastal erosion and accumulation. We do not think that anything is gained by the comparisons with military operations, made by Mr. La Gorce in a series of journalistic titles and descriptions. These tend, indeed, to divert attention from the interesting records that he has brought together.

STILL further exactitude is given to our knowledge of the minerals of the silica series by Messrs. J. B. Ferguson and H. E. Merwin (*Amer. Journ. Sci.*, vol. xlvi., 1918, p. 417). The melting-point of tridymite has now been determined for the first time, and is given as $1670^\circ \pm 10^\circ$, while that of cristobalite proves to be $1710^\circ \pm 10^\circ$, thus justifying Bowen's comments on previous results in 1914.

THE occurrence of copper at certain stratigraphical horizons has been attributed to the accumulation of salts of the metal in the blood of organisms, and Mr. A. H. Phillips, of Princeton, now advances a similar suggestion for vanadium (*Amer. Journ. Sci.*, vol. xlvi., 1918, p. 473). This element has been found in certain ascidians and holothurians. Although it may be detected in almost all igneous rocks, its commercial sources are sedimentary rocks or coals.

THE conclusion that two distinct epochs of drift-deposition are well marked in Iowa is still further strengthened by Messrs. W. C. Alden and M. M. Leighton in the annual report of the Iowa Geological Survey for 1915, p. 49. The strong clay or "gumbo" produced by prolonged weathering of the underlying Kansan drift is overlain by the drift of the Iowan epoch. We must now be prepared for the perpetuation of the quaint term "gumbo," as well as G. F. Kay's "gumbotil," in glacial geology.

THE bulletins of several seismological observatories have reached us recently. The most complete are naturally those published in neutral countries, such as those of the Dutch station of De Bilt, near Utrecht, for the years 1914 and 1915 (*Konink. Nederl. Meteor. Inst.*, No. 108), and of Zi-ka-wei (China) for February to May of the present year. Instead of the annual volume of "Notizie sui terremoti osservati in Italia," the Central Geodynamic Office at Rome has issued a list of Italian earthquakes felt during the year 1916 (*Boll. Soc. Sismol. Ital.*, vol. xx., for 1916, pp. 228–45). The bulletin of the seismological station at Georgetown, U.S.A. (Georgetown University Publication, Bull. of the Seismog. Station, No. 2, 1918), contains the records for the year 1917, and also a list of earthquakes during the same year compiled from newspaper notices and from materials communicated from the Italian observatory of Rocca di Papa. The incompleteness of this list, due to war conditions, is evident from the fact that 90 per cent. of the earthquakes noticed occurred in Italy and the United States.

A REPORT of the Meteorological Committee for the year ended March, 1918, the sixty-third year of the Meteorological Office, has been submitted to the Lords Commissioners of his Majesty's Treasury. The report is in a very condensed form. No change has occurred during the period in the membership of the Committee, Sir Napier Shaw continuing as director, but a large number of changes have taken place in the office staff," many being due to the exigencies of the time. Greatly increased demands are made upon the Office by the Naval, Military, and Air Services, which immensely outweigh the claims of the general public prior to the war. The demand for meteorological instruments, for instance, has risen from 3000*l*. a year to 12,000*l*. The chief feature mentioned is "the great development of pressing demands for expert meteorological assistance, and the prospect of still larger demands in the future." A Naval Meteorological Service is now attached to the Hydrographic Office of the Admiralty, and there has been a large extension of the Meteorological Section of the Royal Engineers, as well as in the Royal Air Force. Post-war problems have involved correspondence with the Ministry of Reconstruction. A knowledge of the weather is stated to be necessary now, not only at the earth's surface in many parts of the globe, but also at elevations. It is stated that among the immediate requirements of the science is the compilation in a reference form of "the information that is at present scattered in scientific journals, and of which the existence is only known to a few experienced meteorologists." The investigation of atmospheric pollution is another branch of work now allied to the Meteorological Office, and there are also the numerous observatories scattered over different parts of the British Isles, all doing admirable and useful work.

Symons's Meteorological Magazine for September seems meagre to those accustomed to the remarkably complete statistical details and the useful and interesting map of the rainfall in the Thames Valley. The magazine has now been issued for fifty-two years, and this is the first time that it has "failed to contain statistical data of the preceding month." The difficulties arising from the war are referred to, and mention is made of the increased labour and strain. "The last difficulty, however, springs from one of those conditions against which 'the gods themselves fight in vain,' and we have to submit. Time will, no doubt, overcome this difficulty also, and when it does so the tables and maps missing will be forwarded to all subscribers." In the current number an article is given on "The Water-power of the British Empire," based on the Preliminary Report of the Water-power Committee. Speaking for the editors of *Symons's Meteorological Magazine*, the article claims that "in the *Geographical Journal* for April, 1896, more than twenty years ago, we elaborated a scheme for the complete geographical description of the British Isles, with special reference to the survey of natural resources, and the time estimated for the completion of the work was twenty years. Had the scheme, which perished in a general chorus of praise of its promise, been carried out, the Ministry of Reconstruction would now have before it a mass of elaborated data, the like of which cannot now be obtained in time to guide the after-war development of the country." The correspondence on "Ashdown Forest Climatology," suggested by a walk of two meteorologists, is interesting, dealing with rain and mist formation, and it calls to mind meteorological work in the neighbourhood by Prince, of Crowborough.

IN an interesting article on "Pure Science and the Humanities" (*Queen's Quarterly*, vol. xxvi., 1918, pp. 54–65) Mr. J. K. Robertson acts as a daysman between two disciplines which ought never to have been at variance. The student of the humanities has chiefly to do with man and his activities, intellectual, literary, artistic, social, and political, in the past and the present. But he uses scientific methods; he cannot abstract man from his cosmic stage and its scenery; and he knows how scientific discoveries affect human thought and life. Therefore, when he is wise, he looks on science as in natural alliance, not in hostility. The student of science has, in the main, to do with the order of Nature. But he cannot exclude man and his works, not even his dreams; he has to study the history of his science, which often shows itself as a social phenomenon; he has his "formal discipline" as rigorous as that of the classics; his every-day work stirs the imagination, and is often rich in æsthetic stimulus; and he knows that his science may contribute, not only to the glory of the Creator, but also to the relief of man's estate, as Bacon put it. Moreover, both kinds of discipline require the same qualities of intellectual conscience—accuracy, veracity, patience, and courage. There is no sense in trying to make things that are different seem the same, but the author shows that what should be looked for, in the name of common sense, is sympathetic co-operation. For the two disciplines are complementary, equally natural and equally necessary.

THE U.S. Bureau of Standards will supply on request Technologic Paper No. 113, which contains a description of the Bureau's method of determining the permeability of balloon fabrics, together with a discussion of the effect of various experimental conditions on the results obtained. The method is essentially an elaboration of Frenzel's modification of the N.P.L. method. The fabric is in contact on one side with a stream of hydrogen; over the other side air is passed at a measured rate, the concentration of hydrogen in it being determined by a one-meter Rayleigh-Zeiss gas interferometer. By reducing the depth of the gas- and air-chambers of the permeability cell to 2 mm. and 4 mm. respectively, the period required for the attainment of equilibrium conditions is shortened to about thirty minutes; the results are accurate to about 5 per cent. Curves are given for the effect of temperature and of hydrogen excess pressure on the permeability. The standard temperature adopted is 25° C.; the permeability at 15° C. is about 65 per cent. of that at 25° C. The influence of aqueous vapour is noted, dried gases giving an observed permeability about 5 per cent. greater than when they are two-thirds saturated. Vapours of rubber solvent may affect the readings; if necessary, a correction is applied from blank tests. The permeability of balloon fabric by air is found, by a suitable variation of the interferometer method, to be on the average 1/3·8 of the permeability by hydrogen.

THE column of smoke usually emitted by a steamer is a vital factor in betraying her presence to an enemy. Thus a tramp steamer with the usual type of funnel emits a column of smoke to a height of 150 ft., which is visible to an observer whose eye is 15 ft. above sea-level and 17·4 nautical miles from the steamer. The danger is reduced considerably by a smoke system developed by Messrs. Yarrow and Co., Ltd., and described in the *Engineer* for September 13. The device consists of two smoke-ducts leading from the funnel to each side of the ship, the exit-mouths of the ducts being inclined downwards towards the surface of the sea. A damper in the funnel and other dampers in the ducts permit the funnel to be closed and the ducts opened. Each duct has an internal water-spray, which delivers a conical spray arranged just to touch the exit edges of the ducts. The effect of this spray is to cool the hot gases so as to cause them to fall to sea-level, and to absorb a large proportion of the solid particles of carbon in the smoke, thus reducing its blackness, and therefore its visibility. In actual use, the smoke never rises above the level of the bridge, and its appearance is similar to that emitted by a locomotive, which is black only for a minute or two after the furnace-fires have been stoked afresh. The control of the air supply to the furnaces is also improved by the device.

THE successful testing last month of the new Quebec Bridge marks the completion of a great work which has claimed the attention of engineers for many years past. An interesting article will be found in *Engineering* for September 13, which includes many excellent illustrations from photographs, showing the construction of the bridge and the methods employed in erection. The structure is of the cantilever type resting on two piers, 1800 ft. centre to centre; the two cantilever arms are each 580 ft., and the span is completed by a central suspended girder of 640 ft. span, under which there is a free headway at high water of 150 ft. The two anchor-arm spans are each 515 ft., and the total length of the whole structure, including approach spans, is 3239 ft. There are two railway tracks, and outside these two footpaths. The collapse of the first bridge during erection in August, 1907, has undoubtedly influenced American bridge design for the good. A contributory cause to the accident was the ridiculously small sum set aside for professional advice, which made the provision of an adequate scientific staff impossible. This lesson was taken to heart in the design of the new bridge; the preparation of the plans for the official design of the new structure is said to have cost 100,000*l.*, and a board of engineers was constituted to supervise the plans and erection. Numerous tests were made on models of the lower chord compression members (which were the cause of the disaster to the first bridge), and it is of interest to note that some of these "models" exceeded in size the principals of most bridges.

A NEW series of monographs on experimental biology and general physiology is announced by the J. B. Lippincott Co. The general editors will be Dr. J. Loeb, Prof. T. H. Morgan, and Prof. W. J. V. Osterhout. Among the volumes arranged for are "The Chromosome Theory of Heredity," Prof. T. H. Morgan; "In-breeding and Out-breeding," E. M. East and D. F. Jones; "Localisation of Morphogenic Substances in the Egg," Prof. E. G. Conklin; "Tissue Culture," R. G. Harrison; "Permeability and Electrical Conductivity of Living Tissue," Prof. W. J. V. Osterhout; "The Equilibrium between Acids and Bases in Organism and Environment," L. J. Henderson; "Chemical Basis of Growth," Prof. T. B. Robertson; "Primitive Nervous System," Prof. G. H. Parker; and "Co-ordination in Locomotion," A. R. Moore.

Mr. Edward Arnold announces "Petrol and Petroleum Spirits," by Capt. W. E. Guttentag, with a preface by Sir John Cadman; *Messrs. Longmans and Co.'s* list includes a new and enlarged edition of "Liquid Steel: Its Manufacture and Cost," by Col. D. Carnegie and S. C. Gladwin; *Messrs. Crosby Lockwood and Son* promise "The Aircraft Identification Book for 1918: A Concise Guide to the Recognition of Different Types and Makes of all Kinds of Aeroplanes and Airships," by R. B. Matthews and G. T. Clarkson, and a new edition of the "Naval Architect's, Shipbuilder's, and Marine Engineer's Pocket Book," by C. Mackrow and L. Woollard; *Messrs. G. Routledge and Sons, Ltd.*, have in preparation for their New Industrial Efficiency Books series a translation by E. Butterworth of "The Human Motor and the Scientific Foundations of Labour," by Dr. J. Amar, "The Science of Labour and its Organisation," by Dr. J. Ioteyko, and "The Taylor System in Franklin Management," by Major G. D. Babcock.

OUR ASTRONOMICAL COLUMN.

TWENTY-FOUR-HOUR TIME IN THE ARMY.—An Army Order issued last week states that from October 1 the system of twenty-four-hour time reckoning, starting from midnight, will be adopted throughout the British Army. This system is already in general use at sea, and we hope that its introduction into the Army is a step towards its adoption by the general public. Attempts were made in this direction thirty years ago; Sir W. Christie had the gate-clock at Greenwich arranged to show this time, and it was suggested that astronomers should change the commencement of their day from noon to midnight, so as to have a single system for all purposes. Both proposals collapsed at that time owing to insufficient driving-power, but they are now being revived with better prospects of success. There is a great probability that the various astronomical ephemerides will from the year 1925 use the day commencing at midnight; the necessity of preparing these ephemerides many years in advance makes an earlier change impracticable. But there is no reason why the general use of twenty-four-hour reckoning should not begin sooner. If the railway companies could be induced to use it in their time-tables it would prevent all confusion between a.m. and p.m., and would also accustom the public to the system. The Army Order states that four figures are always to be used for hours and minutes; for example, 4.7 a.m. will be written as 0407. This is a convention already familiar to American astronomers.

WOLF'S COMET.—The following ephemeris for Greenwich midnight is by M. Kamensky (*Astr. Journ.*, No. 738):—

Date		R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Oct.	1	20 12 33	13 11	0·2416	0·0242
	5	20 17 0	11 46	0·2375	0·0267
	9	20 22 6	10 22	0·2336	0·0299
	13	20 27 51	8 59	0·2298	0·0337
	17	20 34 10	7 39	0·2262	0·0380
	21	20 41 8	6 22	0·2228	0·0430
	25	20 48 35	5 7	0·2196	0·0485
	29	20 56 34	3 56	0·2166	0·0544

The theoretical brightness is greatest on October 12, but the physical brightness is likely to increase up to the time of perihelion.

BORRELLY'S COMET.—The following ephemeris for Greenwich midnight is by L. v. Tolnay (*Astr. Nach.*, No. 4955):—

Date		R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
Oct.	1	5 38 8	9 38	0·1733	9·9614
	5	5 45 51	8 44	0·1689	9·9424
	9	5 52 21	7 42	0·1648	9·9229
	13	6 0 39	6 32	0·1610	9·9029
	17	6 7 42	5 13	0·1576	9·8825
	21	6 14 29	3 42	0·1545	9·8616
	25	6 21 0	1 58	0·1518	9·8403
	29	6 27 12	0 0	0·1496	9·8189

The comet is likely to be an easy telescopic object at the end of October and in November.

THE NEW STAR IN AQUILA.—Preliminary accounts of photographs of the spectrum of Nova Aquilæ obtained at the Lick and Mount Wilson observatories have been given by Dr. G. F. Paddock and by Messrs. W. S. Adams and A. H. Joy (Pub. Ast. Soc. Pac., vol. xxx., No. 176). Observations were commenced at Mount Hamilton on June 10, and at Mount Wilson on June 8, and in each case the plates include the visual as well as the photographic part of the spectrum. Descriptions of the spectra are in general accord with previous accounts, and show that the nova followed the usual spectral transformation. Among other details Dr. Paddock refers to the extraordinary changes in position and intensity which took place in a pair of absorption lines at wave-lengths 4058 and 4064. The green nebular line was first recorded on June 23, and the line 4363 on June 22. A table of bands measured on a plate taken on June 21 includes lines in the red at 6299, 6367, 6467, besides Hα, and lines in the yellow at 5876 (D_3), 5753, and 5675. The Mount Wilson observers classify the earliest spectrum of the nova as of type A, with very broad hazy bands of hydrogen, displaced about 20A to the violet. The magnesium line 4481 was also present, and displaced by the same amount. Of special interest is the observation that a large number of the absorption lines on June 11 could be identified with lines in α Cygni, when allowance was made for a displacement of the nova spectrum amounting to 20A at Hγ, and directly proportional to the wave-length in the case of other lines. The nebular bands at 4363 and 5007 were indicated as early as June 20, and the latter had become well marked by June 23.

Numerous observations of the nova are summarised in Circular No. 208 of the Harvard College Observatory. The first record at Harvard was on May 22, 1888, when the photographic magnitude of the star was 10·5, and from that date to June 3, 1918, as shown on 405 plates, the brightness was subject to small but undoubted changes. On June 7 the star was of the 6th magnitude, and on the following night brighter than 1st magnitude. Subsequent observations are tabulated to July 22, and show that after the star began to fade the light fluctuated by half a magnitude at intervals of about ten days. The oscillations were accompanied by marked changes in a line at 4059 in the spectrum of the nova.

A large number of estimates of the brightness of the nova are also included in an interesting article by M. Flammarion which appears in the August issue of *L'Astronomie*.

THE METALLOGRAPHY OF TUNGSTEN STEELS.

MANY investigations of tungsten steels have been made, but there has, as yet, been no systematic study of them, and their structural constitution is almost unknown. The steels themselves have long been important in an industrial sense, in that tungsten is an essential constituent of many magnet and rapid-cutting tool steels. The remarkable fact that the initial temperature from which they are cooled and the rate of cooling determine the position of the critical points has long been familiar to metallurgists, but hitherto there has been no completely satisfactory explanation of it. The publication of a systematic study of the magnetic qualities and metallography, not only of the tungsten steels, but also of carbonless iron-tungsten alloys, by Honda and Murakami in the recently issued science report (vol. vi., No. 5) of the Tohoku University is therefore to be welcomed.

The authors have constructed a preliminary equilibrium diagram of the iron-tungsten system, from which it appears that only one compound, Fe_2W, as put forward by Arnold and Read, exists. At ordinary temperatures iron dissolves this tungstide up to a concentration corresponding with 9 per cent. of tungsten. In steels which contain tungsten above this concentration the tungstide appears as small globules scattered through the crystals, which were formerly considered to be a double carbide of iron and tungsten.

In tungsten steels the tungsten exists either as the carbide, WC, or the tungstide, Fe_2W, or in both forms according to the percentage of tungsten and carbon. In the normal state the tungsten carbide and iron carbide exist as a double carbide, $4Fe_3C.WC$, which has its critical point at 400° C. as compared with 725° C. for pure iron carbide. Above the Ac_1 point this double carbide dissociates into its components, but if the maximum temperature is not very high these recombine during cooling, and are deposited from solid solution at 400° C., forming a eutectoid with the ferrite. Above 1100° C. the following reaction occurs,

$$WC + 5Fe = Fe_3C + Fe_2W,$$

and during cooling the lowering of the transformation points occurs in consequence of the dissolved tungstide in austenite. The greater the carbon concentration in the system, however, the less does the above reaction proceed.

The lowering of the Ar_1 transformation due to heating increases with maximum temperature, and this depends on the tungsten, but not on the carbon content. Above 9 per cent. of tungsten, however, corresponding with the maximum solubility of this metal in iron, the lowered Ar_1 point is constant at about 440° C. If, now, a specimen which has a lowered Ar_1 point be reheated just beyond the Ac_1 point (about 900° C.), and then cooled, the transformation takes place at the normal point. This is due to the fact that tungsten carbide is formed in the Ac_1 range according to the reaction,

$$Fe_3C + Fe_2W = WC + 5Fe,$$

and during cooling the recombination of the tungsten carbide with the remaining iron carbide occurs. The authors are to be congratulated on their careful magnetic and metallographic analyses, which have enabled them to present a clear and very plausible conception of the chemical, structural, and phase changes which occur in tungsten steels both on heating and cooling.

H. C. H. C.

FUEL ECONOMY.

THE economical use of coal has been referred to frequently in these columns, but with all the various proposals for its more efficient application for power production the possibilities of effecting marked economies with existing boiler-plants have not been fully appreciated. In the columns of *Engineering* (July 12 and 19) Mr. D. Brownlie gives data of the examination of 250 boiler-plants, comprising 1000 boilers and using annually more than two million tons of coal. Seventy-six per cent. of the plants were hand-fired, the average net efficiency being 57·8 per cent.; the remainder, mechanically fired, show an efficiency of only 61·4 per cent. Only 9·6 per cent. of the plants show a higher efficiency than 70 per cent. Certainly these figures indicate very bad practice, for a net working efficiency of 75 per cent. may well be aimed at. Reorganisation of the plants examined to reach this figure would alone entail a saving of 430,000 tons of coal annually; throughout the country it would possibly lead to a saving of 15,000,000 to 20,000,000 tons. As Mr. Brownlie points out, "the question of the economical generation of steam will always be a very important part of the greater national scheme of coal economy, even if all the power of the country is generated by gas-engines and the by-products of the distillation of coal." As a large part of the power will undoubtedly be steam-generated in existing plants for many years to come, the improvement of the efficiency of these plants is urgently called for during the period which must elapse before the general reorganisation of the whole system of power production can be carried out.

Further evidence on fuel economy is contained in Bulletin No. 31, Circular 7, of the University of Illinois Engineering Experiment Station. This bulletin deals with the operation of hand-fired power plants, and the matter is presented in a manner readily understood by those who are not experienced engineers. About 6,000,000 tons of coal are consumed annually in Illinois in operating hand-fired power plants, and it is believed to be within the limits of practical attainment to effect a saving of from 12 to 15 per cent. of this fuel. Descriptions and drawings are given of simple appliances and the methods of using them explained, whereby the men who fire the coal may obtain precise information regarding the best working conditions for given steam consumptions. With proper attention these appliances enable the correct working conditions to be reproduced at any time, and also give evidence which leads to the detection of defects in the plant which would not otherwise be suspected. The section dealing with the storage of coal is of interest, and contains a very suggestive statement:—"Do not undertake to store coal until you are sure you know how to do it properly and safely." The circular has been compiled by a committee of the University authorities, aided by an advisory committee including several well-known names, and can be commended to the notice of all who desire to introduce scientific control in their boiler plants.

SALARIES IN SECONDARY AND TECHNICAL SCHOOLS, ETC.[1]

THE chief duty of this Committee, as defined in the terms of reference, was "to inquire into the principles which should determine the fixing of salaries for teachers in secondary and technical schools, schools of art, training colleges, and other institutions for higher education (other than university institutions)." They were specifically asked not "to consider the question of the amounts by which existing salaries should be improved."

Progress in the higher education of the nation depends, in the first instance, upon attracting and retaining, by means of adequate salaries and suitable salary scales, the services of the most capable and highly qualified teachers. The present rates of payment fail to secure this. The report states (p. 52) that the average salary of 3350 full-time assistant masters in 403 grant-aided boys' secondary schools in England and Wales on January 31, 1917, was only 187*l.* per annum. The average salary of 4294 assistant mistresses in similar schools was 130*l.* per annum. Out of 1050 secondary schools in England and Wales receiving grants from the Board of Education, in only 460 of these schools were salaries regulated by definite scales in January, 1917. Salary scales were, in general, only short scales covering a period of five or six years, the average maximum for graduates (men) being only 196*l.* 7*s.* The information in the report respecting salaries in technical schools, polytechnics, etc., is much less detailed and precise (p. 41). It would appear, however, that on March 31, 1914, the average salary of heads of departments and assistant teachers in these institutions was about 180*l.* per annum.

In view of the inadequate salaries just mentioned, especially with the higher cost of living, increased taxation, and the more generous remuneration now offered by commerce, industry, and the State services, it is no wonder, even allowing for certain recent improvements, notably in London, that the Committee

[1] Report of the Departmental Committee on Salaries in Secondary Schools, Technical Schools, etc. (Cd. 9140.) (H.M. Stationery Office.) Price 6*d.* net.

reports:—"We have no doubt that a very great increase of salaries is necessary . . . it has been brought home to us that the teaching services are experiencing increasing difficulties in attracting a reasonable share of the young men and women who give evidence of outstanding ability." This is felt more particularly in the technical schools, where the leakage from the profession and the difficulty of obtaining new teachers, due to the low salaries, the absence of salary scales, and the higher payment offered in industry, is raising serious obstacles to the development of technical education.

The principal recommendations of the Committee are as follows:—

(*a*) *Secondary Schools* (p. 25).—A minimum initial salary for (graduate) teachers in all secondary schools in receipt of public money should be fixed by the Central Authority, and a minimum amount prescribed at a later stage in the teacher's career. Salaries of assistant teachers should be regulated by scales. They should be such that teachers receive a substantial salary at the age of thirty-two or thirty-three, with increments continuing up to the age of about forty-two or forty-three. Normally, increments should be annual and automatic (subject to reasonable conditions as to efficiency). Equality of pay for the two sexes would, in existing circumstances, lead to one being underpaid and the other overpaid. No differences in salary should be made upon the basis of the subject taught or the size of the school. The possession of a high degree or other special qualification of a scholastic character may be recognised by placing its holder at a point on the scale above that which he would otherwise occupy. Heads of departments and assistants performing special duties should be remunerated by additions to their salary.

(*b*) *Technical Schools*.—Full-time assistant teachers of senior and advanced students, who are graduates or have qualifications equivalent to graduation, should be paid by scale at as high a rate at least as is paid in secondary schools, higher remuneration being given in exceptional cases where a teacher's qualification consists of long works experience and high technical knowledge. The salary may be determined by what will induce him to leave his occupation, otherwise the scale should be similar to that of the secondary-school teacher. The salaries of artisan teachers will be settled in the main by competition with industry.

The above recommendations respecting salaries in technical schools, bringing the payment of the full-time assistant lecturer up to that of the secondary-school teacher, would mean a great advance if carried into practice. Thus in London the assistant lecturer in a technical school or polytechnic rarely rises above 250*l*., whereas the secondary-school teacher may rise to 400*l*., or 450*l*. in special cases.

The Committee deals also with salary scales in schools of art, training colleges, etc., in a similar manner to its proposals relating to secondary and technical schools. An important general recommendation respecting the application of new scales to existing teachers states that this should not be too long drawn out, and there should be no avoidable delay in giving to every teacher some immediate and substantial instalment of any intended advance.

The proposals of the Committee, if carried into effect, would go far to remove one of the chief obstacles to the improvement of the higher education of the nation. There still remains, however, as regards salaries, the not unimportant question of the salaries of assistant lecturers in university colleges and similar institutions. Despite much criticism and a certain amount of agitation, these salaries still remain in a most unsatisfactory condition, even when compared with the new maximum salary of the L.C.C. elementary-school class-teacher (240*l*. or 300*l*.), or that of the London secondary-school assistant teacher (300*l*. non-graduate, 400*l*. or 450*l*. graduate).

J. WILSON.

HIGH-TEMPERATURE PROCESSES AND PRODUCTS.[1]

IN comparing workshop processes at present in use with those employed twenty years ago, many striking changes may be noted, all tending to cheaper and more rapid production. It will be found, on examination, that some of the most important of these changes are due to the utilisation of high-temperature processes, or to appliances in which new materials produced at high temperatures are employed.

At the present time, when the economic generation of electricity in this country by the aid of large, central power-stations is under consideration, the present and future importance of high-temperature processes and products cannot be too strongly emphasised. In any scheme that may be evolved, provision should be made for electric-furnace work on the large scale, as otherwise we shall remain, as heretofore, dependent upon other countries for many essential materials.

One of the most recent applications of the oxy-hydrogen flame is to the spraying of metals on to cold surfaces. In what is known as the Schoop process the metal, in the form of wire, is fed into the interior of the flame, where it is melted and then blown by compressed air, in a state of very fine division, on to the surface to be coated. The arrangement is such that when the size of the flame is increased or decreased, the feed of wire is changed simultaneously, so that the rate of deposit per unit area is constant. The finely divided metal fills all the interstices of the surface upon which it impinges, and becomes firmly attached; and by continuing the process any desired thickness may be deposited.

The thermit reaction has also been applied to the production of pure metals, and has proved of great value in cases where it is necessary to secure a product free from carbon. In the manufacture of special classes of steel in which manganese or chromium is used, it is desirable that these elements should be free from carbon, in order that the final carbon content may be regulated to any desired amount in the finished product. As prepared by furnace methods, these metals always contain carbon to a greater or less extent, and hence for high-class steel the carbon-free metals produced by the thermit method are preferable, although more costly.

Before the war the thermit industry was in German hands, and it is a matter for congratulation that the present British proprietors have been able to reproduce practically all the compositions which previously were imported. This is an excellent example of the value of research in applied science.

The rapid increase in the output of electric steel is due to several causes, chief amongst which are (1) the superior properties of the product, (2) the possibility of producing steels according to a given formula without difficulty, (3) the greatly reduced loss from oxidation of light steel scrap fed into the mixture, and (4), which applies specially to Britain, the possibility of obtaining a cheap supply of energy in certain localities. When all these factors are taken into account, high-grade steel can be produced more

[1] Abridged from Cantor Lectures delivered before the Royal Society of Arts in January and February, 1918, by Mr. C. R. Darling.

economically by the electric furnace than by the aid of fuel.

Furnaces of thirty tons capacity have been constructed, and this is considered by some authorities to be the upper limit of economic size. One of the chief drawbacks at present is the rapid deterioration of the refractory lining; but this trouble will no doubt be overcome by the production of durable refractories by electric-furnace methods. In the event of one or more of the super-power stations proposed by the Coal Conservation Committee being erected near London, it is quite possible that the metropolis may become an important centre of the steel-refining industry.

Direct oxidation of the nitrogen in the atmosphere may be effected by the electric arc, and several types of furnace have been designed for the production of nitric acid by this means.

Two other chief methods of nitrogen fixation, involving high-temperature processes, have been introduced: the Serpek process, in which aluminium nitride is first formed, and from which ammonia is obtained by treatment with water; and the cyanamide process, in which nitrogen is passed over heated calcium carbide, yielding the compound $CaCN_2$, from which ammonia may be obtained by treatment with steam. In each case the ammonia produced may be converted by catalytic means into nitric acid.

The pre-war consumption of carbide in this country was about 30,000 tons, of which all but about 2000 tons was imported. The small quantity made at home came from the works of the British Carbide Products, Ltd., at Thornhill, where power was obtained from the Yorkshire Power Co. The demand for carbide for various purposes has greatly increased during the war, and the works of the company named have now been removed to Clayton, near Manchester, where furnaces have been installed capable of turning out 15,000 tons per annum, power being taken from the Manchester Corporation.

Whether the manufacture of carbide in Britain will become a large and profitable industry depends upon the success or otherwise of schemes for producing cheap electrical power.

The history of carborundum furnishes one of the romances of science, and shows how a small laboratory experiment may result in the establishment of a large and prosperous industry.

The main reaction in the production of carborundum is shown by the equation $SiO_2+3C=SiC+2CO$. Carborundum is therefore chemically silicon carbide. In the manufacture on the large scale a mixture of sand, coke, and a quantity of common salt is placed in the electric furnace round a core of granular carbon, through which the current passes. The portion of the mixture adjacent to the core is converted into carborundum to a certain depth, beyond which a partial conversion only takes place, forming what is known as "fire-sand."

The chief sources of carborundum are the electric furnaces of the Carborundum Co. at Niagara, and of the Norton Co., Chippewa, Ontario, the product of the latter company being designated by the trade name "Crystolon."

Abrasive articles of carborundum are now manufactured in this country by the Carborundum Co., Ltd., at Manchester, the raw material being obtained from Niagara. Carborundum grindstones are now used in most engineering works, and in the small form are employed largely by dentists.

Carborundum sand, the outer zone product, is used for lining brass furnaces, silicate of soda being used as bond. It is also used, mixed with fireclay, as a furnace lining, as a moulding sand for aluminium, and for many refractory purposes.

By using a smaller quantity of carbon, the element silicon may be prepared in large quantities in the electric furnace, the reaction being $SiO_2+2C=Si+2CO$. The formation of silicon was first noted in the carborundum furnace, in which small quantities may be found; and this led to the production of silicon as the primary substance, when desired, by reducing the proportion of carbon as shown. The element silicon thus became available in bulk, whereas previously it was more or less a laboratory curiosity. Silicon does not oxidise below 1200° C., and is useful as a resistance material for electricity, particularly when strong currents are used which make the resister very hot. Its specific resistance is about three times that of carbon.

The fusion of the mineral bauxite, an impure form of oxide of aluminium, results in the production of a crystalline material inferior in hardness to carborundum, but superior in strength. In grinding steel, or materials of high tensile strength, an abrasive material is needed which will not break under the pressure which must be applied, and in such cases it is found that grindstones made from fused bauxite are quite satisfactory, whilst carborundum wears away too quickly owing to the breaking of the crystals. Fused bauxite is manufactured into grindstones by the Norton Co. in America under the name of "Alundum," and a similar product is marketed by the Carborundum Co. of Manchester, which is termed "Aloxite."

As an abrasive for steel, fused bauxite is unrivalled, and, together with carborundum, has made possible the introduction of grinding machinery which for many purposes is preferable to steel cutting-tools, producing a better finish in a shorter time.

Whilst used primarily as an abrasive, fused bauxite may be made into an excellent refractory, and the alundum ware produced by the Norton Co. is extensively used for the tubes of small resistance furnaces, crucibles, pyrometer sheaths, etc. In making articles of this kind the powdered alundum is mixed with a suitable bond, and the object moulded from the mixture and afterwards fired. The product so obtained has a low coefficient of expansion, and withstands sudden changes of temperature far better than porcelain, but not so well as silica. It is relatively a good conductor of heat, which property fits it for the purposes named; and its high melting-point—2050° C.—renders it suitable for work at temperatures which would cause fused silica to devitrify. It has the further advantage of being inert towards platinum at high temperatures, and is, therefore, suitable for platinum-wound resistances furnaces. Ordinary alundum is porous, and this property has been put to use for filtration purposes in laboratories, the liquid to be filtered being poured into a crucible, in the pores of which the finest particles of precipitate are retained. As the alundum is unattacked by most acids, solutions may be filtered which would destroy filter-papers. In the form of various articles alundum has now become firmly established as a useful laboratory material.

Moissan was one of the first to notice that ordinary amorphous carbon could be converted into graphite by the aid of intense heat; but the commercial production of artificial graphite was due to Dr. E. G. Acheson.

The process of manufacture consists in passing a powerful electric current through coke, anthracite coal, or carbon obtained from petroleum residues, producing a temperature of 3700° C., which suffices to convert ordinary carbon into graphite. The materials are placed in a loose-walled furnace, which can easily dismantled to remove the products; and at the temperature employed most of the impurities volatilise and escape as vapours through vents in the walls.

Artificial graphite possesses the advantage over the natural variety that it may be produced in large, homogeneous masses, and does not require any binding materials. It may be machined with ease by ordinary workshop tools; thus it may be turned in the lathe to any desired shape or size, and may be filed, drilled, and threaded. Ordinary carbon, however prepared, is much more troublesome to work, and soon destroys the tool-edge.

In the electrolysis of solutions such as common salt, in which nascent chlorine is liberated, anodes of artificial graphite are superior to others, not being attacked by chlorine. In other cases in which corrosive substances are liberated by the electrolysis, such as the recovery of copper and nickel from residues, the same superiority is shown, and consequently artificial graphite is extensively used in such cases.

The superior conductivity of graphite renders it more suitable for filling the space between the two plates of a dry cell than carbon. A further advantage is its greater purity, so that it is not liable to cause local action. Special grades of graphite powder are made for this purpose, and find a wide application in cells for flashlights, telephones, and numerous military purposes.

Artificial graphite has found a certain application as a lubricant in the forms of "oildag" and "aquadag," both of which were introduced by Dr. Acheson. The graphite used in these cases is first ground down to a powder which will pass through a sieve of 40,000 meshes to the square inch, and afterwards treated chemically so that it forms a colloidal suspension in oil or water. Graphite of this character is said to be "deflocculated," and when suspended in a liquid will pass readily through a filter-paper. When added to oil the lubricant "oildag" is formed, and its use on a bearing results in the production of a thin layer of graphite on the rubbing surfaces, which, when formed, enables efficient lubrication to be carried on with a greatly diminished feed of lubricant.

When rock-crystal or sand is heated to fusion and allowed to cool, it remains in a vitreous condition, and then possesses properties resembling those of glass.

In making tubes a current of sufficient power is passed through a graphite core surrounded by sand, which is fused to a depth determined by the time the current passes. Care must be exercised not to exceed a temperature of 2000° C., as otherwise there would be a danger of the carbon and silica reacting to form carborundum. The core is then withdrawn, and the plastic mass pulled out into tubes of the required dimensions. By arranging the shape of the core, pieces with closed ends can be made, and afterwards blown in moulds to any desired shape by means of compressed air. A weight of 200 lb. of fused silica can now be produced and manipulated, thus rendering it possible to manufacture articles for commercial processes. A similar method is now followed in making transparent silica from pure quartz.

In the best modern plant for the manufacture of nitric acid from saltpetre, the product is condensed in silica-pipes, which may be water-cooled without danger of cracking; and in concentrating sulphuric acid silica basins are now used. The production of the enormous quantities of these acids needed for the manufacture of explosives has been much facilitated by the use of silica apparatus; and, in addition, the output of vessels and pipes of various kinds has proved of advantage to chemical industries generally, in all cases where acid- and heat-resisting properties are of importance.

It will be recognised by all who have studied the matter closely that the future industrial success of any country will largely depend upon the extent to which it develops high-temperature processes.

One of the first essentials will be a cheap and abundant supply of electricity, and it is to be hoped that not only the sixteen super-power stations proposed by the Coal Conservation Committee, but also many others, will be erected, entirely apart from considerations of economy in coal.

It is now possible to purchase electric power as cheaply at Newcastle as at Niagara, the great centre for electric-furnace products; and there appears, therefore, to be no economic reason why carborundum and graphite, for example, should not be manufactured in England. The development of cheap-power schemes should lead to the establishment of many new industries in this country, provided the necessary enterprise and capital be forthcoming.

One effect of the war has been to create a general appreciation of the value of research in connection with industry, and efforts have been made in many directions to make good our previous negligence in this respect.

So far as high-temperature processes are concerned, our record is not one of which we may be proud, as, with the exception of silica ware and aluminium, we are dependent on other countries for materials which have now become indispensable. The chief reason for this has, no doubt, been the absence of cheap electricity; but now that this is to be remedied, no time should be lost in commencing high-temperature research on various lines. Amongst problems awaiting solution may be mentioned the smelting of tungsten and other metals of very high melting-points, and the formation of alloys of these metals; the production of suitable refractories for use in electric furnaces generally; and the manufacture of the diamond on the large scale for abrasive purposes. Apart from these obvious lines of research, the production of new compounds as the result of high-temperature reactions offers a boundless field for investigation, and should lead to important industrial developments. It is only necessary to consider the results which have accrued from the heating of coal and lime, coal and sand, and carbon alone, in the electric furnace, to realise the possibilities in this direction, and the imperative need for research on the lines indicated.

A good electric furnace, capable of taking charges which would enable commercial possibilities to be deduced, should be installed at all the leading centres of scientific instruction. One or more such furnaces, devoted to general research, should be established in London; and, speaking from personal knowledge, there would immediately be many firms desirous of submitting problems the solution of which would be an aid to the industries in which they are engaged.

It is to be hoped that before long high-temperature research will be flourishing in this country as it has been for some years in America. The factories at Niagara, with their enormous output of various materials, are the outcome of this research, and given adequate facilities in this country for investigation, there is no doubt that we should reap our full share of the future developments which are certain to arise in this field of work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

UNIVERSITY OF LONDON.—The sum of 1000*l.* has been given to the University by the National Bank of South Africa for the promotion of Dutch studies.

A COURSE of three lectures on "Scientific Factory Management" will be given by Dr. A. D. Denning at the London School of Economics and Political Science on Mondays, beginning on October 28.

AT the Pharmaceutical Society of Ireland, Mr. W. H. Ashmore has been appointed professor of materia medica, in succession to Dr. M.

Thomson, resigned, and Mr. H. Norminton professor of practical chemistry.

According to *Science*, the College of Physicians and Surgeons of San Francisco has discontinued the teaching of medicine, but for the next three years it will grant diplomas to such students as shall complete their work satisfactorily in other medical schools.

At the opening of the new session of the London (Royal Free Hospital) School of Medicine for Women, the inaugural address will be given by Miss A. Maude Royden at 3.30 on Tuesday, October 1. The subject of the address will be "Revolutionary Thought."

The opening of the winter session of the medical school of the Middlesex Hospital will take place on Tuesday next, October 1, at 3 o'clock, when Lt.-Gen. T. H. J. C. Goodwin, Director-General, Army Medical Service, will occupy the chair. The prizes will be distributed by the Dowager Countess Brassey, and Dr. Browning, the director of the hospital's pathological laboratories, will deliver an address. All who are interested in the hospital and its medical school are invited to be present.

The technical colleges and schools throughout the country are now assembling for the winter session, and the prospectuses which reach us provide good evidence of their continued healthy activity. The Birkbeck College, London, opens on September 30, and has arranged day and evening courses of study for the University of London examinations in the subjects of the faculties of arts, science, laws, and economics. The West of Scotland Agricultural College, Glasgow, opens on October 10. It has arranged comprehensive courses in preparation for diplomas and degrees in agriculture, dairying, forestry, horticulture, poultry-keeping, and bee-keeping.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 9.—M. P. Painlevé in the chair.—A. **Denjoy**: Demonstration of the fundamental property of the curves of M. Jordan.—C. **Viola**: The laws of Curie and Hoüy. The law of simple rational indices, Hoüy's law, can be deduced from Curie's law.—A. **Guébhard**: Remarks on the ferrisphere.—M. **Lecointre**: The marine Pleistocene of Chaouia (Western Morocco).—L. **Léger**: Geographical distribution of the anophelic zones in the south-east of France: method of study.—R. **Leriche** and A. **Policard**: The mechanism and pathogenic *rôle* of premature osseous rarefaction in the genesis of pseudo-arthroses.

September 16.—M. P. Painlevé in the chair.—E. **Picard**: Some remarks on the decomposition into primary factors and the prolongation of analytical functions.—P. **Appell**: Simultaneous linear partial differential equations and cases of reduction of hypergeometric functions of two variables.—C. **Richet**, P. **Brodin**, G. **Noizet**, and F. **Saint-Girons**: Ohmhemometer for measuring the electrical resistance of the blood. Application to clinical practice. The resistance of a drop of blood is measured in a capillary tube by Kohlrausch's method. A close relation was established between the electrical resistivity, density, and number of red corpuscles.—Ch. **Depéret**: Attempt at a general chronological co-ordination of Quaternary times.—M. **Balland**: Some coffee preparations proposed for the Army. Analyses are given of coffee extracts, tabloids, and some coffee substitutes.—E. **Cartan**: Developable varieties in three dimensions.—P. **Humbert**: Electrospherical functions in the form of determinants.—A. **Guilliermond**: The mitochondrial origin of plastides.—G. **Truffaut**: The partial sterilisation of soil. Large-scale experiments, in which carbon bisulphide, calcium sulphide, and tar-oils were used for the purpose of partial sterilisation of the soil, gave results generally favourable, confirming the work of E. J. Russell and Miège.

Washington, D.C.

National Academy of Sciences (Proceedings, vol. iv., No. 4), April, 1918.—W. J. V. **Osterhout** and A. R. C. **Haas**: Dynamical aspects of photosynthesis. Ulva, which has been kept in the dark, begins photosynthesis as soon as it is exposed to sunlight. The rate of photosynthesis steadily increases until a constant speed is attained. This may be explained by assuming that sunlight decomposes a substance the products of which catalyse photosynthesis or enter directly into the reaction. Quantitative theories are developed to account for the facts.—Kia-Lok **Yen**: Mobilities of ions in air, hydrogen, and nitrogen. Extensive experiments, the results of which are in perfect accord with the "small-ion" hypothesis, as contrasted with the "cluster" hypothesis.—E. H. **Hall**: Thermo-electric action with dual conduction of electricity. A continuation of previous papers. The hypothesis of progressive motion by the "free" electrons only has been extended to the case of dual electric conduction.—C. G. **Abbot**: Terrestrial temperature and atmospheric absorption. The earth's surface sends out 0·50 calorie per cm.^{2} per minute on the average, and of this only a small part escapes to space. Hence the atmosphere is the main radiating source, furnishing three-fourths of the output of radiation of the earth as a planet.—Kia-Lok **Yen**: Mobilities of ions in vapours. A continuation of the study of the vapours SO_2, C_2H_6O, C_2H_4O, C_5H_{12}, etc., with the conclusion that the small-ion theory is further corroborated.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of the South Sea Islands. Thirty detailed chemical analyses of lava from the South Pacific Islands are given, with a discussion of the results.—J. **Loeb**: The law controlling the quantity and rate of regeneration. The quantity of regeneration in an isolated piece of an organism is under equal conditions determined by the mass of material necessary for growth circulating in the sap (or blood) of the piece. The mystifying phenomenon of an isolated piece restoring its lost organs thus turns out to be the result of two plain chemical factors: the law of mass-action, and the production and giving off of inhibitory substances in the growing regions of the organism.

(Proceedings, vol. iv., No. 5), May, 1918.—W. S. **Adams** and A. H. **Joy**: Some spectral characteristics of Cepheid variables. The hydrogen lines are abnormally strong in Cepheid spectra, which are classified, first, on a basis of the hydrogen lines, and, secondly, on the more general features of the spectra.—C. **Barus**: Types of achromatic fringes.—C. **Barus**: Interference of pencils which constitute the remote divergences from a slit.—E. **Doolittle**: A study of the motions of forty-eight double stars. A classification of the stars is set up for the purpose of determining those pairs upon which observations are most urgently needed.—H. **Bateman**: The structure of an electromagnetic field. All electrical charges are supposed to travel along rectilinear paths with the velocity of light. When electricity appears to move with a smaller velocity, it is made up of different entities at different times.—O. E. **Glenn**: Invariants which are functions of parameters of the transformation. A general discussion of a systematic theory and interpretation of invariantive functions which contain the parameters of the linear transformations which leave invariant a binary quadratic form, including the invariants of relativity.

(Proceedings, vol. iv., No. 6), June, 1918.—F. G. **Benedict** and P. **Roth**: Effects of a prolonged reduction in diet on twenty-five men. I. Influence on basal metabolism and nitrogen excretion.—W. R. **Miles**: Effect of a prolonged reduction in diet on twenty-five men. II. Bearing on neuro-muscular processes and mental condition.—H. M. **Smith**: Effects of a prolonged reduction in diet on twenty-five men. III. Influence on efficiency during muscular work.—C. E. **McClung**: Possible action of the sex-determining mechanism.—E. **Blackwelder**: The study of the sediments as an aid to the earth historian.—G. H. **Parker**: The growth of the Alaskan fur seal herd between 1912 and 1917. Since 1912 the steady increase in the number of pups born and of harem bulls, and the decrease since 1913 of the average harem, are most favourable signs in the growth of the herd. The one unfavourable feature during this period is the considerable increase in idle bulls in 1915, 1916, and especially in 1917. This increase, which can be eventually checked, shows that active commercial killing should have been restored some years ago.—W. N. **Berg** and R. A. **Kelser**: The destruction of tetanus antitoxin by chemical agents. The results indicate that tetanus antitoxin is a substance of non-protein nature, but the stability of the antitoxin is so dependent upon that of the protein to which it is attached that whenever the protein molecule is split, the antitoxin splits with it.—G. P. **Merrill**: Tests for fluorine and tin in meteorites, with notes on maskelynite and the effect of dry heat on meteoric stones.—F. W. **Clarke**: Notes on isotopic lead. Investigations on the atomic weight of various forms of lead, and radio-active estimates of the age of minerals, are analysed for the purpose of throwing light upon isotopes and the structure of chemical elements.

(Proceedings, vol. iv., No. 7), July, 1918.—G. H. **Hardy**: The representation of a number as the sum of any number of squares, and in particular of five or seven.—A. **St. John**: The crystal structure of ice. Ice is properly assigned to the hexagonal system, and consists of four inter-penetrating triangular lattices, of which the fundamental spacings have been obtained.—W. M. **Davis**: Fringing reefs of the Philippine Islands. An interpretation of recently published large-scale charts of the United States Coast and Geodetic Survey.—W. S. **Halstead**: Dilation of the great arteries distal to partially occluding bands. The relative amount of constriction required to give the most pronounced results has been determined, so that the author is able in almost every instance to produce the dilation, and a large amount of material thereby accumulated is analysed.—A. A. **Michelson**: The correction of optical surfaces.

BOOKS RECEIVED.

The Neo-Platonists: A Study in the History of Hellenism. By T. Whittaker. Second edition, with a Supplement on the Commentaries of Proclus. Pp. xv+318. (Cambridge: At the University Press.) 12*s*. net.

Petroleum Refining. By A. Campbell. Pp. xvi+207. (London: C. Griffin and Co., Ltd.) 25*s*. net.

Practical Surveying and Field Work. By V. G. Salmon. Pp. viii+204. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Practical Chemistry for Intermediate Classes. By Prof. H. B. Dunnicliff. Pp. xii+277. (London: Macmillan and Co., Ltd.) 5*s*.

Food Gardening for Beginners and Experts. By H. V. Davis. Second edition. Pp. viii+133. (London: G. Bell and Sons, Ltd.) 1*s*. net.

Modern Engineering Measuring Tools. By E. Pull. Pp. viii+115. (London: Crosby Lockwood and Son.) 4*s*. 6*d*. net.

Rats and Mice as Enemies of Mankind. By M. A. C. Hinton. Pp. x+63. (London: Trustees of the British Museum.) 1*s*.

Seaside Planting for Shelter, Ornament, and Profit. By A. D. Webster. Pp. 156. (London: T. Fisher Unwin, Ltd.) 18*s*. net.

Coast Erosion and Protection. By Prof. E. R. Matthews. Second edition. Pp. xvi+195+frontispiece+32 plates. (London: C. Griffin and Co., Ltd.) 12*s*. 6*d*. net.

New Reduction Methods in Volumetric Analysis. By Prof. E. Knecht and E. Hibbert. Re-issue with additions. Pp. x+135. (London: Longmans and Co.) 5*s*. net.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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NOTICE.

In consequence of the greatly increased cost of production it has been found necessary to raise the price of NATURE to 9d. The alteration will take effect beginning with the issue for October 24, from which date the Annual Subscription rates will be as follow:—Inland, £2 . 2 . 0; Foreign, £2 . 5 . 9.

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BOARD OF AGRICULTURE AND FISHERIES.

The President of the Board of Agriculture and Fisheries is prepared to consider applications for the post of ASSISTANT BACTERIOLOGIST (Temporary) on the staff of the Fisheries Division. The appointment will be for one year in the first instance, and a salary of £500 is attached to the post.

Applications should be submitted to the SECRETARY, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. 1, on or before October 21, 1918, on a form which, together with a memorandum stating the conditions of appointment, may be obtained on application to the above address.

HENRY G. MAURICE,
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THURSDAY, OCTOBER 3, 1918.

THE ECONOMY OF NATURE.

La Géologie biologique. Par Prof. S. Meunier. Pp. vii+328. (Paris: Librairie Félix Alcan, 1918, dated 1914.) Price 5.50 francs.

IN the present-day economy of Nature the various associations of living creatures work into one another's hands, so that a moving equilibrium results. One of the main ideas of Prof. Meunier's "Biological Geology" is that analogous associations have existed in the past in similar correlations, the same biocosmic *rôle* being discharged by successive types. After illustrating the geological activity of organisms in forming and weathering deposits, and in the ceaseless circulation of matter, the author takes an interesting survey of the various haunts of life and their interrelations, and brings forward evidence to show that in past ages there was a somewhat similar biocosmic pattern, with hydroplankton, hydronekton, hydrobenthon, aerial animals, terrestrial animals, even commensals, symbionts, and parasites.

Taking the sedimentary rocks in some detail, the author shows the part that organisms have played in the formation of calcareous, siliceous, phosphatic, sulphurous, carbonaceous, and other deposits, and in the erosion of rocks which their predecessors had helped to form. The author's emphasis is all on continuity—a continuity of "terrain," an ocean with the same chemical character since life began (as Silurian salt deposits testify), an atmosphere without any great change, a continuous biocosm since the pre-Cambrian, with "a continuity of *régime.*" Obviously the biocosm loses members, but others take their place, so that there is no change in general equilibrium, or in what Prof. Meunier goes the length of calling the "impeccable harmony" of interrelations. In emphasising a truth the author commits an exaggeration.

It is strange that a naturalist who lays so much stress on continuity should be a champion of the theory that new forms appear suddenly. Thus in speaking of the appearance of *Cardium porulosum* in the beds at Grignon he writes: "What Nature seems to show us is a brusque phenomenon, without hint of a precursor of any kind, as the result of which a living creature comes to add itself to the series already existing." What occurs is not a transformation of species, but a replacement. A species has a life and "personality" like an individual: it is born, it develops, it reaches its climax, it wanes, it exhausts its share of "vital force," and disappears, only to have its place taken by another species, slightly different, but likewise in harmonious relation with the constant properties of the environment. Prof. Meunier recognises the profound changes which the intervention of vital activity made in the economy of the earth, but once organisms had firmly established themselves there has been, he maintains, no environmental change of moment, only change in secondary features, such as the distribution of surface temperature. It seems a strange position to recognise that the appearance of organisms changed the whole venue, and yet to deny that the establishment of grasses and mammals, of flowering plants and their insect visitors, and so on, has made no appreciable difference in the animate environment.

The author seems to us to have missed a cardinal fact—the evolution of the environment—and to have failed to realise how complex a system of relations the present-day environment of an able-bodied, active-minded animal is. Yet he lays emphasis on what animals and men are continually doing in modifying their environment. These modifying agencies seem to Prof. Meunier to show how well adapted the general environment is to the exigencies of organic life. The constancy of environmental influences, which we believe he exaggerates, appears to him to form a "decisive objection against every transformist doctrine that supposes organismal transformations to have been determined by external changes." But transformists are not restricted to any crude Lamarckism. To Prof. Meunier vital energy is a dynamic entity, like crystallogenic energy, capable of passing from one heavenly body to another like light or heat, capable also of remaining for a long time latent, but likewise of manifesting itself in favourable environment, and of expressing itself in a "perfectionnement organique" as time goes on.

It seems to us that the day is past for half-hearted evolutionists, and we have no sympathy with Prof. Meunier's extraordinary view that evolutionists are embarrassed by finding among aquatic animals so many different solutions of the problem of respiration, or by knowing that in the course of ages cetaceans have shown no trace of any transformation of lungs into gills. The best idea in the book is that the earth and sea and sky and all that in them is form a sort of organism that grows as a whole with continuity, keeping up a harmonious correlation, a balance, a *systema naturae*, which changes from age to age, and yet remains in principle the same.

WATER SUPPLIES FOR RURAL DWELLINGS.

Rural Water Supplies and their Purification. By Dr. A. C. Houston. Pp. xv+136. (London: John Bale, Sons, and Danielsson, Ltd., 1918.) Price 7s. 6d. net.

THE private isolated water supplies of the scattered rural population are often dangerously polluted; and there are many who would be glad to do what is possible to remedy matters, if they were informed of the dangers they run and the best practical means of escaping from them. But this small work will not prove of great value to the majority of dwellers in rural districts, whose need is for some simple, detailed expedients for easily reducing the risk and inconvenience attendant upon a water supply which is unsuitable from the point of view of either quality or quantity (or, maybe, both); for the book is almost entirely devoted to the means available for purification by chemical methods. These methods are the least easy of adoption of all known methods of guarding against water-borne disease in the dwelling, where even simple domestic filters so rarely receive the comparatively little attention they require to maintain satisfactory working conditions.

The author points out in his preface that the expert will find little by way of instruction in a book which is offered more particularly to those who are inexperienced, but zealous to learn. This latter class of reader will be confused and discouraged by all the chemical matter included.

Where the consumer is at risk from specific water-borne infection the domestic methods of sterilising water are so rarely a success that the practical sanitarian advises them only as a *dernier ressort*; he always favours the safer alternative of adopting every available means of preventing such contamination. But the problems of obtaining in rural districts drinking water that is satisfactory in quality and quantity, and of guarding its purity, are so lightly discussed in this work that the reader will look in vain for usefully detailed guidance under this head.

The author is conscious of the shortcomings of his statement, for his final paragraph is as follows: "In this brief account of rural water supplies and their purification, the author has doubtless failed in many particulars, but if the reader cares to write and explain his (or her) difficulties, or to offer any suggestions or criticisms, the author will endeavour to answer any such communications to the best of his ability." If the work is extensively read by the uninitiated, it should bring him much correspondence. The following are among the questions that may be raised even by the well-informed reader: Is it not taking an extreme view with reference to roof-collected rain-water to regard it as "potentially unsafe, if not actually dangerous," from the point of view of water-borne infection, and therefore to maintain with reference to it that "the first thing to consider is how rain-water can be best sterilised"? Is it really "out of place" to describe methods of separating the first washings from the roofs, and of collecting and storing rain-water in bulk; and, if so, why is this done on pp. 124–28?

The book is disappointing, the more so because it is written by one whose practical work upon water supplies has won for him much well-merited recognition.

A NEW ZOOLOGICAL STATION

Tropical Wild Life in British Guiana. By William Beebe, G. I. Hartley, and P. G. Howes. With an Introduction by Col. T. Roosevelt. Vol. i. Pp. xx + 504. (New York City: New York Zoological Society; London: Witherby and Co., 1917.) Price 12*s*. 6*d*. net.

THIS handsome volume, profusely illustrated with original photographs of scenery, plants, and animals, is the first-fruits of a new zoological station which has suddenly come to blossom in British Guiana whilst the Old World was already in the midst of the all-absorbing war.

The sub-title explains this unexpected growth: "Zoological Contributions from the Tropical Research Station of the New York Zoological Society." In the words of one of the authors, it marks the beginning of a wholly new type of biological work, capable of literally illimitable expansion. It provides for intensive study, in the open field, of the teeming animal life of the tropics. Cordial hospitality is extended to all naturalists to secure, without jealousy, from whatever source, the most thorough research possible. Every original investigator fit to work in the field is sure of an eager welcome and of all possible aid in his studies.

Mr. Beebe, with his previous experience of British Guiana (*cf.* "Our Search for a Wilderness," New York City, 1908) as directing curator, and Mr. Hartley and Mr. Howes as research associates, established themselves in March, 1916, at Kalacoon House, Hills Estate, Mazaruni River, British Guiana, and stayed there untii August, 1916. The place is about 40 miles from the coast, near the Essequibo River, just above the marshy alluvial zone, still within reach of the tide. Schists and outcropping granite, clay subsoil and sand-dunes, are all covered with dense jungle. The field of intense operation was restricted to half a square mile around the station, a clearing for india-rubber. Close by a square mile is covered with second growth, some three years old, already 20 ft. high, affording valuable comparison with the primeval forest, since this new area is composed of its own flora and fauna.

Work was begun at once. The present book is not a traveller's account. It plunges at once into observation and reflection concerning ever so many topics. For example, the jungle is divided into four horizontal zones, each with its characteristic flora and fauna—floor, lower, mid, and tree-tops—of which the middle zone is the heart of tropical life, whilst that above is still a closed book, for the obvious reason that it is hopeless to sit and observe on the top of the jungle. However, the authors hope next time to find ways and means to establish themselves comfortably aloft.

Concerning birds, the favourite study of the director, nearly 300 kinds were observed, half of which were omnivorous, 12 per cent. wholly vegetarian, and 38 per cent. entirely insectivorous. And, mark, "no trace of a butterfly or moth was found in any of the 400 stomachs examined." There are many observations as to diet hitherto unsuspected. The caracara, a reputed scavenger, sated himself with seeds and insects. Swallow-tailed kites, instead of terrorising other birds, lived on small fruit and large grasshoppers. Vultures were rare—at least, careful search of the sky never revealed one—but any carcass left deep in the jungle, out of sight, was within two or three days surrounded by various kinds of these birds. Being devoid of the sense of smell, were they attracted to the spot by the buzzing of flies, or by the direct droning flight of the great scarabs?

Much is said about coloration. Mr. Beebe's "infallible test" whether a bird is protectively coloured or not is whether it "freezes," counting upon being overlooked, or whether it goes off. Lists of such and other birds are given, and many of the real, or apparent, exceptions are scrutinised. Some explanation is always available where personal bias is not hampered by actual knowledge in this "optical tower of Babel of the tropical forest."

One chapter is devoted to the life of the hoatzin, with excellent photographs of the scenery, nests, and the climbing and swimming of the unfledged babies. All this is glorified into a miracle, with conclusions about the origin of birds rather startling and a little overdone. The staff took no end of trouble about the nesting, eggs, and young of various other birds, especially toucans, about which nothing was known.

Mr. Hartley has contributed chapters on the development of external features. There is a lively chapter on the perai or cannibal fish, the *piranha* of the Brazilians. Mr. Howes treats of the life-histories of bees and wasps, with coloured plates. Mr. Rodway, of the Georgetown Museum, writes on Indian charms, and the Rev. W. G. White contributes notes of the Hinterland of Guiana.

Altogether this is a very valuable first instalment of a most promising enterprise.

DRUGS AND THEIR PREPARATIONS.

The Dispensatory of the United States of America. Twentieth edition, thoroughly revised and largely re-written by Prof. J. P. Remington and others. Pp. cxxii + 2010. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 2*l.* 10*s.* net.

IT is now three-quarters of a century since the first edition of the United States Dispensatory was published. During that period it has grown from a volume of 1073 pages to one of nearly double that size, and simultaneously enhanced its reputation as a standard work of reference for matters pharmaceutical.

The revision of the work for the present edition was accomplished by the late Prof. Remington, whose loss all pharmacists deplore, and Dr. Horatio Wood, assisted by Prof. Sadtler (Chemistry), Prof. LaWall (Pharmacy), Prof. Kraemer (Pharmacognosy), and Dr. Anderson. It has long been recognised that in the preparation of so compendious a volume, embracing various branches of knowledge, the co-operation of experts in those branches must be enlisted, and this plan has here been followed with most admirable results.

The issue of new editions of the United States and British Pharmacopœias and of the National Formulary, the appearance of many new non-official remedies, and the rapid increase in our knowledge of official remedies, have necessitated a vast amount of work by the compilers. It may at once be said that the compilation has been excellently accomplished, with the result that the United States Dispensatory is now a mine of information on all matters relating to pharmacy. It includes practically all the drugs and preparations of the United States and British Pharmacopœias and of the National Formulary, and also such of the German and French pharmacopœias as are in common use in the United States.

The preliminary pages (122) are devoted to the (American) Food and Drugs Act, to Food Inspection decisions, to the Harrison Anti-narcotic Law, a glossary, an index of diseases, and so on. The body of the work is divided into three parts. Part i. deals with all the remedies in the United States and British Pharmacopœias, part ii. with the National Formulary and non-official remedies, and part iii. with tests, test solutions, weights and measures, the art of prescribing, and cognate matters such as alcohol tables, etc.

As part i. comprises more than 1200 pages of closely printed text, it is obvious that the various remedies are comprehensively dealt with. As an example, the account of Acacia (gum arabic) may be utilised to show the extent of the information given and the method adopted for its arrangement. After an enumeration of the various species of Acacia that yield commercial gums, and a brief note on the products other than gum obtained from the tree, the nature and cause of the exudation and the method of harvesting the gum are described. Then follows an elaborate description of official and non-official varieties of gum. The general properties, chemical composition, and tests occupy three columns, the article concluding with incompatibles, adulterations, uses, and official preparations. It will be seen, therefore, that the treatment is very comprehensive and that it is possible in a few minutes and in a single volume to inform oneself very thoroughly about gum arabic. The other preparations and drugs are similarly treated, more or less extensively according to their importance. Here and there one misses the latest researches; thus in the excellent, historically arranged account of the chemical examination of rhubarb the investigations of Tutin and Clewer appear to have been overlooked, as also under "Scammoniæ Radix" those of Power and Rogerson. Such omission is, however, quite exceptional, and reference to the United States Dispensatory may be relied upon for rapid, concise, and comprehensive information on almost any drug or preparation that is or has been used in pharmacy.

OUR BOOKSHELF.

School Entomology: An Elementary Text-book of Entomology for Secondary Schools and Agricultural Short Courses. By E. Dwight Sanderson and L. M. Peairs. Pp. vii + 356. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7*s.* net.

THIS little book is one of "Wiley's Technical Series," for the use of "various" schools in the United States of America, where such educational matters of economic importance are well looked after, and a lesson might profitably be learned in this country in that respect. Unfortunately, it deals mainly with insects of the American continent and so cannot fill the want here. It is divided into two parts, the first dealing with general entomology, the second with economic entomology. The junior author is responsible for part i., the senior for part ii.

The illustrations are numerous, and those in part ii. excellent, being mainly reproductions from the publications of the United States Department of Agriculture. Most of those in part i. are photographic reproductions, and this process does not lend itself to this subject, some of the figures being very indistinct and fogged and taken from very badly set specimens. The various orders are dealt with in a clear and simple manner, and there is a chapter on insect collection.

In the economic part the following are dealt with: insects affecting man and domestic animals, including ticks, mosquitoes, fleas, and warble-flies; insects affecting household goods; field-crop insects; and garden and orchard insects. There is also an excellent chapter on insect control, and appendices dealing with useful papers and books on American insect pests. F. V. T.

The Chemical Analysis of Iron: A Complete Account of All the Best-known Methods for the Analysis of Iron, Steel, Pig-iron, Alloy Metals, Iron Ore, Limestone, Slag, Clay, Sand, Coal, and Coke. By A. A. Blair. Eighth edition. Pp. 318. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 21s. net.

BLAIR'S "Chemical Analysis of Iron" has long since made a name for itself among technical manuals. About a quarter of a century has elapsed since the writer of this notice first used the book, the second edition of which had just been published; and it is not surprising to find that so useful a work is still in demand.

Much has happened in the world of iron analysis since those days. Chiefly the changes have been in the increased use of steel alloys containing more or less of the "rare" elements, such as vanadium, uranium, molybdenum, and tungsten; and also of the "alloy metals," such as ferro-tungsten and ferro-molybdenum. Methods of analysing the former group have been brought together in this edition of the book, and a separate section has been allotted to the alloy metals. To chemists who have used former editions it will suffice to say that the present one has been recast and partly rewritten to include improvements of processes, but preserves its former characteristics of concise accuracy and judicious selection of methods. To those unacquainted with the book it may be said that they will find in it all the information necessary for carrying out iron and steel analysis to any degree of completeness that may be desired. The working details are sufficiently full, but not overelaborated, and users will find the volume a trustworthy, practical guide. C. S.

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 Study of English in Italian Universities.

MY friend, Prof. Piero Giacosa, of Turin, wrote to me some time ago requesting me to hand to you the enclosed paragraph of his letter dealing with the recently initiated attempt to bring about a scheme of educational collaboration between Italy and England. Since he wrote, the announcement has been made public that the Ministry of Public Instruction in Italy has decided upon the establishment of a number of chairs of English in the Italian universities. The suggestion contained in Prof. Giacosa's paragraph has reference to the possibilities of young British graduates acting as "lectors" for a limited period under the regular Italian professors of English, and doing work in this way as assistants to the professor.

The paragraph in question runs as follows:—

"Il Ministro della Pubblica Istruzione in Italia ha chiesto al Consiglio Superiore della Pubblica Istruzione, di dare il suo parere sulla proposta di fondare nelle università italiane cattedre di letteratura inglese. Il Consiglio ha applaudito al proposito del Ministro dichiarandolo di grande utilità per la elevazione della coltura universitaria. Gli studiosi inglesi che intendessero approfittare di queste disposizioni del Governo italiano per fare un corso di lezioni di letteratura inglese in una università italiana, possono dirigersi al Professore Piero Giacosa, Università di Torino, per avere schiarimenti al proposito."

[*Translation*:—"The Minister of Public Instruction in Italy has invited the Higher Council of Public Instruction to express its opinion on the proposal to establish a number of chairs of English literature in the Italian universities. The Council expressed its approval of the proposal, declaring it to be of the utmost value for the development of university studies. English graduates who would desire to avail themselves of these arrangements set up by the Italian Government should apply to Prof. Piero Giacosa, University of Turin, for information."]

EDWARD BULLOUGH.

6 Huntingdon Road, Cambridge, September 25.

The "Salary" of the Lecturer.

MAY I venture to direct attention to a curious inconsistency which appears to have escaped the notice of scientific men as much as it has that of the general public? Men of science and educationists are emphasising the need for a larger number of men and women with scientific training to carry out research, technical and academic, and to aid in the ordinary conduct of affairs, both now and after the war; while, judging from official educational advertisements, men with the highest qualifications are expected to train this new generation for a "salary" that compares most unfavourably with the "wages" of a factory hand. We demand that many shall receive a sound scientific education, and that able teachers for the purpose shall be provided; but either we are not prepared to pay a price which will attract any but mediocre or inefficient teachers, or we expect that those who teach will do so for the love of teaching alone, and will obtain elsewhere the wherewithal to live.

It is not necessary to cite passages from the lectures and writings of our most distinguished scientific men dealing with the paramount necessity for more, and yet more, training in pure and applied science; the columns of NATURE provide, and always have provided, numerous examples. At the same time, any column of educational advertisements will provide numerous examples similar to the following, which are quoted from a recent list of "official advertisements." A well-known Scottish college asks for "an assistant lecturer for physics department; salary 150*l.*" A "chemistry tutor for a large teaching institution in London" is required; he must be "a high honour man, with teaching experience"—so that a youth who has just left college is *not* indicated—and 240*l.* is offered! Thus, either we are satisfied that a large proportion of university and college teaching shall be in the hands of men and women whose market value is only about 200*l.* a year—less than a moderately intelligent manual labourer in a munition factory can earn—or we expect our best-trained and keenest men and women, just because they happen to have the ability to teach or a liking for teaching, to accept a wage which will not allow them to live in a manner fitting to their station, and renders the proper feeding and schooling of their children a constant anxiety, and sometimes almost an impossibility. Certainly there is a third possible explanation: that no one has ever troubled to think about the matter! Is it not time for something definite to be done to remedy this state of affairs—a state which is obvious to anyone who happens to read both the text *and* the advertisements of any scientific journal? Moreover, the outlook for science teaching is serious, because one result of the war will be to open many promising careers to men and women with scientific training, and it is quite safe to say that, unless the position of the university teacher is very much improved, no one who can possibly obtain an appointment elsewhere will undertake the work of teaching unless he or she be a person of independent means.

E. R. MARLE.

B.E.F., September 17.

The Arboreal Descent of Man.

PALÆONTOLOGICAL evidence for the arboreal habit of the stem Placentals has been adduced by Matthew (1904). In particular, for the Primates the derivation of the order from large-brained arboreal Insectivores resembling in many ways Tupaia and Ptilocercus is indicated by many considerations (Gregory, 1910). Therefore, there are two possibilities: either the Hominidæ are directly descended from such a stock, and this is what Prof. Wood-Jones holds, or indirectly—that is, through an intermediate anthropoid stage, as is held by American palæontologists; but even in this case, as monkeys are arboreal animals, it is evident that Hominidæ never passed through a quadrupedal stage.

V. GIUFFRIDA-RUGGERI.

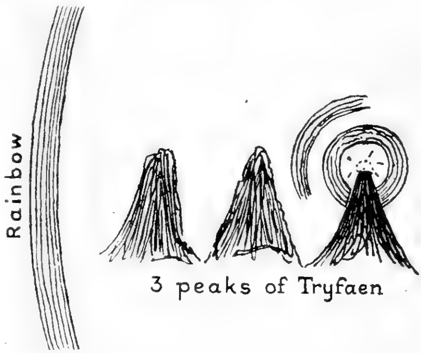
Istituto di Antropologia, R. Università, Napoli, September 17.

A Curious Rainbow.

IN North Wales, on August 20, about two hours before sunset, I saw a rainbow-effect which was quite new to me.

The summit of Tryfaen (some four miles north-east from that of Snowdon) has three sharp, rocky peaks running roughly north and south.

We had climbed up the eastern cliff in a south-westerly gale, which brought up much cloud with some light showers, and were sitting just below the top of the southern peak. The Holyhead road lay north-east and 2000 ft. below us. From it rose the upright portion of a brilliant rainbow. At the centre of its circle was the shadow of our peak with those of the other two peaks to the left of it, all sharply defined. Around the shadow of our peak was a most vivid and persistent bow, the smallest I have ever seen, the radius of the inner edge being about half that of the outer. The central space changed a good deal, being frequently almost filled by a diffused yellow glow, which sometimes appeared to condense towards the centre until it resembled a nebulous sun on a whitish ground, while at intervals little yellow



streamers seemed to radiate from it to the inner edge of the bow. Outside this bow (which had the colours in regular rainbow order, red outside) was part of a third bow of perhaps double the diameter, but dim and intermittent.

We stood up and made gestures, expecting some sort of Brocken effect, but could detect none. However, as we were not on the extreme summit, and the cloud was very distant, our shadows would at best have been extremely minute.

Out of many "Brockens" that I have seen in different parts of the world the most vividly coloured was in Arctic Norway, the most curious and unexpected was on a blazing August day at sea-level in Portugal, and the most realistic on the Mendip Hills in Somerset.

The last was all the more effective for being within an uncoloured and inconspicuous ring.

W. P. H.-S.

GERMAN INDUSTRY AND THE WAR.

II.

IN addition to explosives and what are ordinarily comprised under the term munitions, war requires for its prosecution a great variety of other articles, all of them more or less essential. Chief among these are coal, metals, alcohol, petrol, oils and fats, soap, glycerin, textiles, leather, wood, rubber, turpentine, lubricants, food, surgical appliances, and medicaments. It is of interest to learn how Germany has hitherto managed, in spite of her isolation, to provide herself with these necessaries.

Coal, of course, is needed for motive power, for the production of coke for metallurgical purposes and the by-products of its distillation are required for the manufacture of explosives. Germany, in 1912, produced 175,875,000 tons of coal, and imported 10,480,000 tons, almost exclusively from this country. As regards lignite, in the same year her deposits furnished 80,934,800 tons; in addition she imported 7,276,000 tons from Austria. During the war she has seized large quantities of combustibles in Belgium, the occupied provinces of France, and Luxemburg, some of which she has been able to exchange with neighbouring neutral countries for food and other necessaries. Her main difficulties have been due, not to a shortage of material, but to lack of transport and labour. This last she has to some extent met by compelling Belgian miners to work and by employing prisoners of war. In addition she has rigorously controlled consumption. Factories have been limited in their stocks, and private consumers restricted to 250 kilos. for each fireplace per annum. The distribution is regulated by a special commission, and the question of its rational utilisation is entrusted to the Kaiser Wilhelm Institut at Mulheim, under the direction of Prof. Fischer. Great improvements are claimed to have been made in coking and in the recovery of by-products, which has been made compulsory. Many central power stations have been installed, using the large quantities of gas produced during the coking process and from blast furnaces. There can be little doubt that these measures will permanently benefit industry. It will be found that we shall have much to learn from Germany concerning the scientific use of coal, and we can only hope to maintain our position by bettering her example.

As regards *liquid combustibles* she is much less favourably situated. In 1913 she produced only 71,300 tons, and imported 745,000 tons, of which the United States furnished 574,800 tons, and Austria-Hungary 119,700 tons. The invasion of Galicia by the Russians in 1915, of course, greatly aggravated the situation, and the destruction effected by them on their retreat prevented the Germans from immediately utilising the Galician sources. They have now, to a large extent, recovered them, as well as those of Rumania. The consumption of petrol is severely restricted. So serious was the deficiency at one period that from May 1 to August 31, 1917, its sale by retailers was absolutely forbidden. The institute at Mulheim studied the methods of extracting the hydrocarbons from lignite-tar, but with what success does not appear. Germany even before the war made use of mixtures of alcohol and benzol as motor-fuel usually in the proportion of 75 per cent. of alcohol and 25 per cent. of benzol. Such a mixture cannot, however, be safely used for aviation work, especially in winter.

The exploitation of the stores of *natural gas* known to exist in Transylvania has been actively pursued, aided by subsidies from the Deutsche Bank and the powerful Hungarian banks. The gas is already distributed to Budapest, and is used as a source of power at the cyanamide works of Szentmarton.

The provision of the various *metals* needed for the purposes of war has, however, taxed Germany's energies and her powers of organisation to the utmost.

As regards *iron*, in 1913 she raised 36 million tons of ore, and imported nearly 12 million tons, of which nearly 7½ million tons came from France and Spain, and 4½ million tons from Sweden. She has, however, more than recouped herself for the loss of the French and Spanish ore by her occupation of the Briey basin, which produced 15 million tons in 1913. This ore is highly phosphatic, and yields a basic slag of considerable value for agricultural purposes. The production of cast-steel in Germany has gone up by leaps and bounds during the war. In September, 1914, she produced 663,000 tons, 900,000 tons in the following month, and 1,650,000 tons at the same period two years later. For a time she was able to barter her manufactured iron with neutral countries in exchange for commodities of which she had more urgent need.

Germany possesses only very small deposits of *manganese ore*; in 1913 she imported 680,000 tons, of which 447,000 tons came from Russia, and 178,000 tons from India. She had, however, considerable stocks in hand on the outbreak of war, which sufficed for her needs for some twenty months of hostilities, thanks to the successful efforts of her metallurgists to diminish the proportion of ferro-manganese needed for the production of steel. At the present time the greater amount of manganese needed for German industry comes from Siegerland. The limonites and braunites of Nassau, as well as the deposits of Giessen, Bingerbruck, and the Hartz, are also actively worked. Manganiferous ores have been recently discovered in Carniola and in the Elbogen district. Thanks to the economies in the use of manganese in the manufacture of steel, due mainly to the action of the Mining and Industrial Society of Germany and Luxemburg, and of the Hasper Company, which have gratuitously placed the results of their investigations at the service of her steelmakers, Germany was able to reserve the Thuringian and Hartz deposits exclusively for her chemical industries.

Of all the metals she needs, none has caused her greater concern than the provision of *copper*. In 1913 she imported 225,000 tons, of which 185,000 tons came from the United States, the rest being furnished by England, Serbia, Sweden, and Belgium. In this case she soon felt the influence of the blockade. As is well known, she has remorselessly requisitioned all articles of copper and brass, not only at home, but in Belgium, Serbia, Rumania, Russia, and wherever her armies have penetrated or her submarines have been able to operate. She has substituted iron for copper whenever possible, as in electric conductors and telegraph and telephone wires. She has reopened abandoned workings at Mansfeld and in the Siegerland, at Oberstein, Niedermohr, etc., and of course she has not neglected to utilise the mines of Maidanpek in Serbia. Her internal production of copper grew from 25,300 tons in 1913 to 35,000 tons in 1916; but she has felt the wastage of war with increasing severity, and there is no doubt that the continued provision of copper is becoming practically an insoluble problem.

For *aluminium* Germany before the war was almost wholly dependent upon foreign supplies. In 1913 she consumed about 12,500 tons, of which she imported 4000 tons from France and 6000 tons from Switzerland. As this metal was wholly derived from French bauxite, the exportation of which was forbidden, Germany had to seek elsewhere for the mineral. Bauxite equal to the French material was found in Hungary and Carniola, and works have been established to treat the produce of the valley of the Zud, Bihar, and Kolosz. The Swiss manufactories now use this bauxite, as well as the affiliated German works, at Neuhausen, Mühldorf-on-the-Inn, and elsewhere. The Central Powers are therefore independent of outside sources of supply, and their output of the metal is sufficiently large to enable them to use it in lieu of other metals of which they are deficient. The manufacture of aluminium is now an established German industry.

Germany obtains considerable amounts of *lead* from Upper Silesia and from the left bank of the Rhine. In addition, before 1914, she imported notable amounts of ore from Australia and Belgium. Whenever possible zinc was substituted for lead, and water-pipes were even constructed of papier-mâché. As regards *zinc* she suffered from no special shortage, and its price experienced no very great increase. *Antimony* was largely replaced by other metals, although the works at Przibram, Pernek, and Jaszy still continued to furnish supplies. Most of her *tin* ores before the war came from Bolivia and the Dutch Indies. On account of the blockade she worked some small deposits of cassiterite in the Hartz mountains, but there is no question that she suffered greatly from lack of the metal. All tinning was prohibited, and, indeed, much ware was detinned. It will be remembered that some 181,000 lb. of tin was among the return American cargo of the submarine *Deutschland* in September, 1916. Germany was no less short of *nickel*, for which she was dependent, before the war, on New Caledonia and Canada. Nickel deposits were, however, discovered at Crajova, and have since been actively worked. The *Deutschland* brought back from the United States 752,600 lb. of this metal in September, 1916. Germany obtained all the *mercury* she needed from Austria-Hungary and from Asia Minor. Asia Minor also furnished her with small quantities of *chrome* ore. *Tungsten* and *molybdenum* ores were discovered and worked in Austria-Hungary.

Owing to the necessity of using large quantities of potatoes for food, and as a consequence of the shortage of sodium nitrate as a fertiliser, the production of *alcohol*, so necessary for the manufacture of munitions, experienced a very serious set-back, and a number of methods of meeting the deficiency were employed. Abandoned processes were resuscitated, and new schemes, such as that of working up the sulphite liquors in the manufacture of wood-pulp, already in operation in Sweden, were established. The cellulose factory at Königsberg at the end of 1917 was producing about 1½ million litres of 95 per cent. alcohol by this process. Attempts have been made to effect the synthesis of alcohol from acetylene, itself derived from calcium carbide. As a war measure this may be possible, as also that due to the saccharification of wood by means of dilute sulphuric acid, but such processes can have no permanent effect on German industry. It is only by the most rigorous methods of economy, such as limiting or even forbidding its consumption as a beverage, and by withholding it from certain industries, such as that of celluloid, unless working for the war, that Germany has been able to meet her necessities.

As is well known, the continued provision of oils, fats, and their associated products, soap and glycerin, has occasioned our enemies the greatest concern, and almost every known method of augmenting the supply from internal sources has been resorted to, such as the oxidation of lignite-tar oils and the treatment of ozonides. Various substitutes for soap have been devised, made of clay, kaolin, chalk, etc., mixed with silicate of soda, glue, and an antiseptic such as boric or salicylic acid, with sufficient saponin (usually quillaya bark) to produce a lather. The Kriegs Anschuss placed on the market a soap consisting of fatty acids and saponified resins with clay and sodium carbonate at a maximum price of 20 pfennigs for 50 grams per head per month. This is supplied to hospitals, doctors, and certain groups of workmen. Such industries as textiles, leather, bleaching, and dyeing have been seriously incommoded, and recovery processes have been rigorously insisted upon. The deficiency of fats has of course affected the production of glycerin. Its therapeutic employment has been practically forbidden, and its recovery whenever possible is compulsory. A solution of calcium chloride is employed as a substitute in certain industries. Ethylene glycol has replaced it as a medicament, and in the preparation of films, in printing, and in lithography. Various vegetable decoctions stabilised by antiseptics are also used. Concentrated solutions of lactate of soda and of potash, under the names of "perglycerin" and "perkaglycerin," have been introduced into pharmacy.

The space at disposal does not allow of any account of the methods to which our enemies have been driven in dealing with the urgent problems of textiles, leather, and paper. For *turpentine* they were wholly dependent upon supplies from America, France, and Russia, and a variety of substitutes had to be devised, chief among them "lignite-resin" and "coumarone-resin," the manufacture of which has assumed considerable proportions since the war (11,000 tons in 1916).

Germany had accumulated large stocks of *rubber* prior to the outbreak of war. In 1915 she placed its sale and use under stringent regulation. Various substitutes, such as "Ruttenlattich," the exudation from *Euphorbia palustris,* have been employed. Recovery processes have been largely developed, and foreign gums introduced into the recovered material. It is known also that synthetic methods have been worked out, and are said to be in operation on a large scale. It has been asserted, indeed, that Germany has thereby made herself independent of foreign supplies. At the same time it is known that her commercial submarines brought her upwards of 800 tons of rubber in 1916.

MM. Jaureguy, Froment, and Stephen conclude their interesting account with an appreciative recognition of the services which German chemists have rendered to their country. It is largely owing to their activity that the Central Powers have been enabled to meet the deficiency of *matériel* which the stringent blockade of the Entente has caused them.

THE WAR AND PSYCHOLOGY.

THE effect of the events of the last few years upon any science may be regarded from two points of view. First, it may be asked: In what ways has the science rendered help in the solution of the problems raised by the war? Secondly: How far has the appearance of these problems tended to change the outlook and the future programme of work for the science itself? With regard to psychology, it is now possible to attempt an answer to these questions. We may consider, first, the relation of psychology to medical treatment.

By this time there exist numerous publications dealing with the nature and treatment of the protean malady which is inadequately termed "shell-shock." The methods of treating this complex of disorders are almost as numerous as the disabilities themselves. It may fairly be said, however, that these methods either are psychical in nature, or, if accompanied by physical auxiliaries, contain a relatively generous admixture of mental treatment. They range from *force majeure* in one direction to sympathetic persuasion in another, and to subtle psychological analysis and re-education in yet a third. Let us ask our first question: In what way has psychology helped in the alleviation of these conditions?

A simple, straightforward exponent of "firmness" methods might reply that no knowledge of psychology at all has been needed, but merely the will power and personality of the physician. On examination, however, this answer would be found to refer to his successes only. Not only a particular type of physician, but also an equally specific variety of patient and of malady are required for the achievement of simple victories of this kind. Such treatment is often strikingly successful in the class of case which presents obvious objective disabilities, such as the various kinds of "functional" paralysis. Its value is definitely less in those numerous cases the troubles of which are entirely or mainly of a subjective nature. Such disorders as inability to concentrate attention, loss of memory, insomnia, terrifying dreams, emotional instability, and morbid anxiety may on occasion yield to the "firmness" method. Usually, however, if treated in this way, they merely demonstrate the existence of reciprocal firmness on the part of both physician and patient. As a result of experience, too, it is found that sympathy alone will not suffice to cure many of these patients. A penetrating analysis of the tangle of causes which have led to their present condition, followed by thorough "re-education," is often necessary. In such treatment a knowledge both of psychological theory and of technique has proved to be indispensable.

Moreover, the physician who is at the same time a psychologist has found ample scope for his activity in another direction, the reassuring of his patient. To the ordinary man the idea that other people's minds may work in ways different from his own is usually quite foreign. When, therefore, a great shock causes his mind to develop a new trick he is usually quite unprepared for it, and frequently develops the fear of impending or actual insanity: a fear which, for many very cogent reasons, he keeps to himself as long as possible. This fear may be dispelled if his medical officer is able to impart to him some knowledge of the considerable transient and normal variations in the mental happenings of different individuals.

It is important to point out here that, while a knowledge of the "normal" psychology expounded in the ordinary English text-books has been of no little use, especially in the direction last described, much more help has been obtained from the writings of those workers in the sister science, psychopathology. As is well known, their indefatigable industry and prolific speculation have aroused considerable discussion in recent years. Informed criticism of this work, however, is at present very rare, and it is only fair to say that little of it is to be found in English journals. A change of attitude towards the psycho-analytic movement is now clearly noticeable among psychologists. While at one time psychology dealt merely with the description and classification of "states" of consciousness, there is now universal acknowledgment of the fact that many of our thoughts, beliefs, and actions are due wholly or in part to motives and causes of which we ourselves may be partly or wholly unconscious. To correct such thoughts and beliefs necessitates the discovery of the factors which were originally responsible for them. Hundreds of cases of mental and nervous disorders arising from war experience have demonstrated this truth, which is now clearly realised. Methods owing their origin to the pioneer investigations of Freud, Jung, and others are now being widely used even by workers who do not necessarily agree with the theoretical views held by these writers.

We may now consider the way in which the medical problems of the war have affected the outlook of psychology. It seems certain that after the war greater emphasis will be laid upon the importance of instinctive and emotional factors and upon the power of non-rational beliefs to influence conduct. "Individual" and "social" psychology can no longer be regarded as separate departments. The rather exclusively intellectualistic viewpoint of psychology will be enormously modified and supplemented. In justice to psychology it should be pointed out that in the years preceding the war the beginning of this change of aspect in England was clearly apparent in the writings of such workers as Hart, Ernest Jones, McDougall, Shand, Trotter, and Graham Wallas.

This newer psychology, if properly taught, will be of distinct help to medical men in enabling them to deal more scientifically with the enormous and daily increasing number of mental and nervous disorders which are attributable, directly and indirectly, to the war.

In conclusion, brief reference should be made to another problem the urgency of which is great, but towards the solution of which almost nothing has yet been attempted in our own country. We refer to the scientific selection and training of persons for important tasks demanding special innate and acquired aptitudes and capacities. The war has demonstrated, and is demonstrating, in a depressingly convincing way the ease with which square pegs may be placed—and kept—in round holes. The physical capacities of recruits for the Army have usually been tested before they have been allotted to their special work; but in scarcely any case has there been any scientific attempt to determine how far they are mentally fitted for the exacting tasks allotted to them.

As this article is being written an instructive contrast comes to hand from the Surgeon-General's Office at Washington. In the *Psychological Review* for March, 1918, Major Robert M. Yerkes describes "the history of the organising of psychological military service" in the United States. We may mention here one point of interest. The lowest 10 per cent. and the highest 5 per cent. discovered in the psychological examination of recruits were subjected to a searching individual examination, on the basis of which a special report was made to the medical officer. The example of such a rational attempt to discover the incompetent and the specially competent before, and not after, valuable time has been wasted may be recommended to the consideration of all who are anxious to further the best employment of our human resources.

T. H. PEAR.

THE TOTAL SOLAR ECLIPSE OF JUNE 8, 1918.

OBSERVATIONS of the solar eclipse of June 8 appear to have been very successful on the whole, notwithstanding the general prevalence of cloudy conditions along the path of totality, extending from the State of Washington to Florida. Preliminary accounts of the work of the parties of observers from the Lick and Mount Wilson observatories are given in the August issue of the Publications of the Astronomical Society of the Pacific (vol. xxx., No. 176), and of those from the Yerkes and numerous other observatories in the August-September issue of *Popular Astronomy* (vol. xxvi., No. 7).

Prof. Campbell's party was located at Goldendale, Washington, and on an otherwise completely cloudy day the sun was seen in a perfectly clear gap from less than a minute before totality to a few seconds after the end of totality. With a lens of 6-in. aperture and 40-ft. focal length, pointed directly at the sun, photographs of the corona were obtained which are described as surpassing in definition any previously obtained by the Lick observers. The corona was remarkable for the sheaths of streamers which surrounded all the principal prominences, and Prof. Campbell remarks that "it seems impossible to question that the forces in the sun responsible for the prominences are the forces which are responsible for the coronal streamers situated near the prominences." Excellent photographs of the corona were also obtained with other instruments, and streamers to the east of the sun were recorded to about three solar diameters. Special cameras were employed for registering the brighter stars in the region near the sun for the purpose of testing the Einstein effect, and as stars fainter than 8th magnitude are shown on the plates it is possible that measurements may lead to important results. A spectrogram obtained with a three-prism spectrograph, showing the spectrum of the corona east and west of the sun, with iron comparisons, was taken for the accurate determination of the wave-length of the well-known green line of "coronium," and a preliminary measurement has shown that the wave-length differs very little from 5303·0 A. With a single-prism spectrograph, the well-known coronal lines 3601, 3987, 4086, 4231, and 5303 were photographed, and seven other bright lines were suspected. On these plates the coronal spectrum only extends 6 or 7 minutes of arc from the edge of the sun, and no absorption lines appear in this region; the inner corona thus appears to be radiating its own light, and does not reflect sufficient sunlight to impress the Fraunhofer lines on its continuous spectrum. The irregular distribution of "coronium" was successfully recorded by the use of an objective-grating adjusted for the green line in the third order spectrum. Five observers gave attention to the "shadow band" phenomena at the beginning and end of totality, with results which appear to be more definite and accordant than on any previous occasion. With reference to the origin of these bands, Prof. Campbell considers that the rapid cutting off of the sun's rays before totality, and the reverse process following totality, may conceivably produce temperature or density gradients in the earth's atmosphere which may be favourable to effects upon the solar rays analogous to diffraction.

Prof. E. P. Lewis, who was associated with the Lick observers, employed a large quartz spectrograph, an objective prism with double-image prism for studying possible polarisation in the lines, and a double-image camera for investigating the integral polarisation of the corona. Strong polarisation of the corona was recorded to a distance greater than the solar diameter.

At Green River, Wyoming, where the Mount Wilson observers were stationed, the sun was partly covered by clouds during totality. A fairly good photograph of the corona, however, was secured by Mr. Ellerman with an 8-in. objective of 30-ft. focal length, and Dr. St. John was partially successful in his work on the spectrum of the corona. The scale of the spectrograph employed was 6 A per millimetre in the region of the green line, and the slit coincided with the sun's equator on an image 2 cm. in diameter. An iron arc comparison impressed on the plate leads to the wave-length 5303·204, on Rowland's scale, for the green coronal line on the east limb of the sun, but the west limb was unfortunately obscured by clouds. If it be assumed that the rotation of the corona is of the same order as that of the chromosphere, the corrected wave-length becomes 5303·239. It is important to note that the photograph gave the impression that the green line might have appeared less simple with a stronger exposure. Some valuable records of the spectra of the prominences and upper chromosphere were also secured with a concave grating objective spectrograph.

The principal station occupied by the Yerkes observers was also at Green River, Wyoming. Prof. Barnard obtained photographs of the corona and prominences with a 6-in. lens of 60-ft. focal length, and others with a photographic objective of 12-in. aperture, which are stated to show the prominences with an excellence of definition rarely equalled. An extensive programme of spectroscopic work was planned by Prof. Frost, but the clouds were too dense to permit of successful results in all cases. The chief novelty was the use of a moving-picture camera for recording the successive changes in the chromospheric spectrum near the beginning and end of totality, the ordinary lens of this apparatus being replaced by an objective prism and a lens of 40-cm. focal length. Exposures were made at the rate of sixteen per second, and, in spite of some interference by clouds, many hundreds of interesting spectra were obtained. Photometric measures, and photographs of the coronal rings for measurement of the intensity and distribution of light within the corona, were obtained by Prof. Parkhurst.

An expedition from the Lowell Observatory, under the direction of Dr. V. M. Slipher, was located near Syracuse, Kansas, and here also the sun was covered by thin cloud during totality. The large-scale photographs, however, show much delicate detail, and the shape of the corona is described as lying between the maximum and minimum types. Arches of coronal matter above the brighter prominences were conspicuous, apparently showing the influence of the prominences upon the structure of the corona, as also noted by Prof. Campbell. Numerous spectroscopic photographs were obtained, and one of those taken with a single prism shows the solar absorption lines in the outer corona in addition to the emission lines and continuous spectrum of the inner corona. A preliminary measure gave 5303·0 for the wave-length of the green line. Photographs of the green ring with a slitless instrument show that the irregularities have no relation to those of the hydrogen and helium rings, and there is no obvious correlation between the prominences and the inner corona.

Successful observations were also made by expeditions from the United States Naval Observatory, the Smithsonian Astrophysical Observatory, the Sproul Observatory, and other institutions. The only permanent observatory in the belt of totality was the Chamberlin Observatory at Denver, and it is unfortunate that the 20-in. refractor and other instruments assembled for the occasion could not be utilised on account of dense clouds.

MODERN STUDIES IN SCHOOLS.

THE report (Cd. 9036, price 9*d.* net) of the Committee appointed to inquire into the position of modern languages in the educational system of Great Britain, published shortly after that of the Committee on the position of natural science, which was summarised in NATURE of April 18, p. 135, was awaited with peculiar interest. It was expected to put new life into the modern sides of schools, so that modern language teaching should afford some gift which the study of languages can best provide. The questions really are: What is the part which the study of modern languages shall take in the creative life of the world, and what is its distinctive message? Without some high purpose the modern sides of schools must be dull and mechanical. We looked for inspiration, but have been disappointed. The members of the Committee are not themselves inspired with enthusiasm for the part that modern studies shall take—which the studies alone can take—in the uplifting of the world.

The truth is that with the authors of the report the study of modern languages is their second love. So we are met at the threshold with business and diplomacy. It is true that, later, the report seeks some higher purpose, but only half-heartedly and without the enthusiasm of conviction. Commerce, we are gravely told, "is one of the principal ends of education, if it is not the whole of it"; and the Committee has consulted a large number of commercial firms. But ideals which are springing into life, which it is the essential work of education to foster, may transform the whole of our commercial system—may, indeed, make an end of it. After the war, the report says, "keen emulation will be encountered, lost ground must be recovered, new openings must be found," and so on; and modern languages must be taught so that boys may be prepared to join in this commercial warfare or in the higher warfare of diplomacy. Though it may be questioned whether the success of a nation is due entirely to these things, the Committee leaves no doubt as to its own views. The value of business is stated quite candidly and unconsciously. "Our foreign trade does not comprise the whole of our activities, but the whole of our activities depend upon it." "After the war we shall want it more and more if we are to enter into the commercial conflict and succeed in the struggle" To the honour of schoolboys be it said; they will not be inspired with a consuming zeal for study by these business outlooks on life.

We submit that the duty of the Committee was not to supply service of this kind, or to satisfy the demands of either commerce or diplomacy. Its privilege was to impress new ideals into the service of the State; to inspire and send forth new workers into all parts of the national life. Whatever views we may hold on the historical, social, or economic questions of this or any other country —and the Committee does not conceal its own views—we might have expected in the report nobler foundations for these new modern studies.

The report is on pleasanter ground when it considers the special value of modern languages in the interchange of knowledge and ideas between the nations of the world. The Committee reminds us that no country can afford to rely on its own domestic stores of knowledge and ideals; and scientific workers are advised to make themselves familiar with as many modern languages as possible. "The whole civilised world is a co-operative manufactory of knowledge" and of ideals. "New researches are constantly leading to new discoveries, new and fruitful ideas are giving new pointers to thought, new applications of old principles are being made, and in this work all civilised countries can collaborate." We would that the Committee had made these fruitful thoughts more pronounced and more vital in its report, and that it had shown how to apply them in the school life. It is possible that this union of thought and endeavour between the nations is the gift for which we are searching.

When, however, the Committee definitely turns to the value of modern studies in education it becomes apologetic, and has no advice to offer but that the modern language master should copy his classical colleague and try to live up to his standard of culture. The value of classical studies is set forth in the well-known form, and the search for the new spirit which the study of modern languages might invoke is abandoned.

The opinions of the Committee on educational methods are astonishingly reactionary, and would be alarming if they proceeded from men who were themselves trained in modern studies; but the surprising, and to that extent reassuring, fact is that most of the Committee are men who have gained their inspiration from the classics, and not from modern language study. They lament that "instruction cannot be universal; it must proceed from the more instructed to the more ignorant." Or, again: "Modern studies can only work through the few to the many, through the many to the multitude." This is certainly contrary to natural methods of progress, and is opposed to the modern methods of education which have been suggested by science. It is to be regretted that the Committee did not include any representative of science. The sister Committee on science had the help of at least two modern language scholars.

The report is influenced by the Board of Education. This is easily traced in the appearance of "coherent" education and co-ordination. Coherence appears in most of the Board's circulars. It has worked woeful ruth with evening schools, continuation classes, and technical education. It reaches its sublime limit in the advocacy of classics as the dominant study for admission to the Higher Civil Service—for which the classical education is described as the most coherent of courses of study.

INSURANCE AND ANNUITIES FOR COLLEGE AND UNIVERSITY TEACHERS.

THE recently issued twelfth annual report of the president and treasurer of the Carnegie Foundation for the Advancement of Teaching is one of much importance in connection with the question of life insurance and pension provision for college and university teachers in America. Twelve years ago the above corporation was founded in order to provide pensions for the college and university teachers in the United States, Canada, and Newfoundland, and during this period it has, without doubt, not only proved a boon to the beneficiaries, but also increased the attractiveness of the teaching career. But the experience of the past twelve years and a careful study of the whole problem have led the trustees of the foundation to the conclusion that the principles on which they have acted in the past have been unsound. While insisting that the payment of pensions to men who, like college and university teachers, are in receipt of fixed and rather modest salaries must be regarded as a matter of right, and not of favour, the trustees have become convinced that no system of free pensions can be devised which will not in the end affect the teacher's pay, and that the contributory system of annuities is the only one which society can permanently support.

The trustees are, therefore, driven to the conclusion that the policy of free pensions which has been pursued during the past twelve years is unsound, and they have decided to act sincerely and courageously on the strength of their newly formed convictions, while at the same time acting justly towards those present teachers who have come to regard the present rules of the foundation as in the nature of a contract. An additional reason for reconsidering their policy is found by the trustees in the fact that the very considerable additions which have in recent years been made to the ranks of the teachers promise to impose a strain on the funds of the foundation far beyond their powers to support.

The purpose of pensions is to ensure to the teacher economic independence at the close of his productive life. Without such provision the work of the teacher cannot be carried on without undue care and apprehension, which lower the quality of the teacher's work. But there is another point to which attention is less often given—namely, the necessity of freeing the teacher from the apprehension of the economic dependence of wife and family in the event of his death. In the case of the young married teacher this apprehension is probably more powerful and more detrimental to good work than the former. As the present report emphasises, however, the problem of the annuity cannot be financially separated from the problem of life insurance during the productive period of the teacher's life.

It is of much interest to notice that the conclusions reached here are fundamentally quite similar to those arrived at by the commission on the superannuation system for the federated universities of Great Britain. Whereas, however, in Great Britain, owing to the comparatively small number of teachers involved, and for other reasons, the insurance and annuity contracts are carried out through the agency of existing insurance companies, the trustees of the Carnegie Foundation have decided to found a special teachers' insurance and annuity association to be organised, under the laws of the State of New York, so as to represent primarily the interests of the policyholders, to whose scrutiny and oversight it would be subject. In this way insurance can be effected at a lower rate than is possible with insurance businesses carried on for profit, and the benefits to be derived under the proposed scheme appear to be appreciably greater than those accruing under the British scheme. With regard to the combination of life insurance with annuity provision, the trustees point out that this can be effected best by a combination of so-called term insurance with deferred annuity insurance. By this means, by the payment of the same total sum as is contributed under the pension scheme a much greater protection is given to the dependents of the insured during his productive life, without greatly diminishing the value of the annuity should the insured live to the pensionable age. The suggestion is well worth the consideration of authorities in this country.

ON COLOUR SENSITISED PLATES.

UNDER the above title, in the issues of NATURE of February 18 and 25, 1915, we described the general character and some of the typical uses of colour sensitised plates—that is, plates made sensitive to colours to which the simple gelatino-bromide of silver is practically insensitive. The additional sensitiveness is produced by the incorporation of dyes with the emulsion or by their application to the finished plates, and we pointed out that when a continuous spectrum was photographed on such plates, there was clearly shown the original maximum of sensitiveness of the silver bromide and the new maximum or maxima added as the result of the special treatment. Plates made sensitive to all the colours of the visible spectrum would thus have three or four maxima, instead of only one. This irregularity was obviously one cause of the difficulty of getting the complete control of the colour effect that is desirable.

Shortly after those articles were written, the "Wratten Division" of Messrs. Kodak improved their panchromatic plate so effectually that it showed an almost even sensitiveness to the normal solar spectrum. Messrs. Ilford make a plate with similar characteristics. In these plates there is slight evidence of maxima in the greenish-blue and in the red, but these are so slight that it is often scarcely necessary to take notice of them.

It is obvious that a plate of even sensitiveness is theoretically, and one may add practically, the best and simplest where the general and various control of colour effects is necessary. For three-colour reproduction purposes, for example, where the spectrum has to be divided into three regions —roughly, red, green, and blue—the exposure for each colour is very nearly equal. For orthochromatic work—that is, where it is desired that the degrees of whiteness in the print shall correspond in proportion with the degrees of luminosity in the object that produces them, irrespective of their colour—it is clear that we must use a colour filter that will gradually tone down the action of the red and the blue, giving a curve of transmission similar to the luminosity curve of the spectrum—and such a filter will be green. The general idea that a yellow filter is the proper one to improve the rendering of colour sensitised plates, which was correct with the older plates that were deficient in red sensitiveness, appears still to predominate. A yellow filter with modern panchromatic plates will darken the representation of the blues, but will leave the reds, and colours such as yellow, of which red is a component, too light. The difficulty is to find a suitable green filter; for it is, as a rule, much more trouble to get a green filter to suit one's needs than that of almost any other colour. Of the well-known dyes, naphthol green seems the nearest approach to what is wanted, so far as absorption is concerned. As Prof. Pope has been so successful in his work on dyes, perhaps he will be able to find one that gives a better curve and that absorbs less of the colour that it is desired should be transmitted. Of course, theoretically, for orthochromatic results there is the alternative of reducing the sensitiveness of the plate to red to a proper degree, leaving only the action in the blue excessive, and to be reduced by a yellow filter.

We have just received from Messrs. Ilford a portfolio containing a set of comparative prints produced from a strikingly coloured original, which is included, that demonstrates the great power that one has in the use of their panchromatic plates. A similar portfolio will be sent post free to anyone interested in the subject who applies for it. The first print is from a negative on an ordinary plate, and shows yellow and yellowish green much too dark, red black, and dark blue very light; and a panchromatic plate, without a light filter, gives the red and yellow, especially the red, too light instead of too dark, and the blues are a little improved. The interposition of a light filter that increases the exposure by only three times darkens the blues, strikingly, though not quite enough. Presumably this is a yellow filter, as it leaves the red and yellow and yellowish-green too light. A green filter would have corrected the reds, as well as the blues, as explained above, and a photograph taken through one would have been a most instructive addition to the portfolio.

CHAPMAN JONES.

NOTES.

OWING to the greatly increased cost of production caused by the conditions of war, it has been found necessary to increase the price of weekly issues of NATURE from 6*d*. to 9*d*. The change in price will take place with the issue of October 24. For particulars of the new subscription rates see p. xxxiv.

THE following is a list of the foreign delegates appointed to attend the Inter-Allied Conference on the Future of International Scientific Organisations, which is to be held at Burlington House, Piccadilly, next week:—*Belgium:* M. Lecointe, Prof. Massart, and M. de la Vallée Poussin. *France:* MM. B. Baillaud, G. Bigourdan, A. Haller, Lacroix (permanent secretary, Académie des Sciences), C. Lallemand, Moureu, and E. Picard (permanent secretary, Académie des Sciences). *Italy:* Prof. V. Volterra (Member of the Italian Senate). *Japan:* Prof. Joji Sakurai and M. A. Janakadate. *Portugal:* Prof. B. Freire. *Serbia:* Prof. B. Popovitch and Dr. Zoujovitch. *U.S.A.:* Dr. E. Bumstead, Col. J. J. Carty, Dr. W. J. Durand, Dr. S. Flexner, Prof. G. E. Hale, and Dr. A. A. Noyes. The British delegates are to be nominated during the present week.

THIS year's meeting of the American Association is to take place in Baltimore, Ma., under the auspices of the Johns Hopkins University, from December 27 to 31. Boston had previously been selected as the place of meeting, but as so many men of science are at present working in Washington with matters connected with the war, Baltimore has been chosen to take its place. The activities of the meeting will be mainly directed to the applications of science to the present great struggle.

A WAR Committee of Technical Societies has been formed in the United States of America, with representatives from the following societies and institutes: American Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Gas Institute, American Electrochemical Society, Illuminating Engineering Society, Mining and Metallurgical Society of America, American Society of Refrigerating Engineers, and American Institute of Chemical Engineers.

A MEETING of the Optical Society will be held at the Imperial College of Science and Technology, South Kensington, on Thursday, October 10, at 7 p.m., when the following contributions will be submitted for discussion:—(*a*) "Sources and Magnitudes of Centring Errors in a Sextant," by Naval Instructor T. Y. Baker; and (*b*) "Astigmatism: Interchangeability of Stop and Object," T. Chaundy.

AT the general meeting of the Institution of Mechanical Engineers, to be held at 6 p.m. on Friday, October 18, the following papers will be read:—"A Law Governing the Resistance to Penetration of Metals which are Capable of Plastic Deformation, and a New Hardness Scale in Fundamental Units," Prof. C. A. Edwards and F. W. Willis; "The Value of the Indentation Method in the Determination of Hardness," R. G. C. Batson; and "The Ludwik Hardness Test," Dr. W. C. Unwin.

THE first general meeting of the National Union of Scientific Workers (for the determination of its constitution and to elect its first representative council) is to be held in London in the last week of the present month. Information as to the time and place of the meeting can be obtained from the secretary, Dr. Norman R. Campbell, North Lodge, Queen's Road, Teddington.

MR. A. E. BERRIMAN, chief engineer to the Daimler Co., has been appointed Deputy Controller of the Technical Department of the Department of Aircraft Production of the Ministry of Munitions, in succession to the late Prof. Bertram Hopkinson.

WE regret to have to announce the death of Dr. Henry Dyer, the former first principal of the Imperial College of Engineering at Tokyo, Japan.

BISHOP MITCHINSON, Master of Pembroke College, Oxford, whose sudden death at the age of eighty-five was announced in the *Times* of September 26, was a warm friend of science and a naturalist of the good old-fashioned kind. In 1855 he passed out of the schools at Oxford with two first classes, one in Lit.Hum., the other in natural science. When he went to Barbados as its bishop he was already well grounded in botany, and his knowledge of the British flora was extensive and precise. In Barbados he found a new plant-world to conquer, and sent many trophies home to enrich our national collection. But it was geology that proved his favourite hobby, and the collection of fossils which he amassed and lately presented to University College, London, contains some very interesting forms. A friend recalls with admiration and delight his courage on one occasion as a collector when, with the assistance of some quarrymen, but without official sanction, he blasted down many tons of cliff at Porth-y-rhaw in search of Paradoxides, hoping that this giant Trilobite might retain some traces of its limbs. Fine specimens rewarded his enterprise, but never a sign of a limb, which sufficiently proves that this big creature did not progress by walking. Bishop Mitchinson was a fellow of the Geological Society, and served on its council. Many of the older members still retain a happy memory of their friendly reunions in the Master's lodge, cheered by the genial hospitality of the most genial of hosts.

THE death is announced of Mr. A. S. Esslemont, late Controller of the Optical Munitions, Glassware, and Potash Production Department of the Ministry of Munitions.

THE death is announced, in his sixty-seventh year, of Dr. Byron D. Halsted, who was professor of botany at Iowa Agricultural College from 1885 to 1889, and has since that date occupied a similar chair at Rutgers College, New Jersey. At one time Dr. Halsted was managing editor of the *American Agriculturist*. He was president of the Society for the Promotion of Agricultural Science in 1897, and of the Botanical Society of America in 1900.

THE Salters' Company is establishing an institute to be called "The Salters' Institute of Industrial Chemistry," in connection with which there will be two types of fellowships for which post-graduate students of any recognised university will be eligible, viz. fellowships to enable post-graduate students to continue their studies at an approved university or other institution under the general supervision of the director of the institute; and industrial fellowships to enable suitably equipped chemists to carry on research for any particular manufacturer, under an agreement which will be entered into between the institute, the manufacturer, and the fellow. The Salters' Company is open to receive applications for the post of director of the institute from persons possessing exceptional knowledge of scientific and industrial chemistry.

THE Glaziers Company's luncheon on Wednesday, September 25, to which were invited a number of gentlemen taking a prominent part in the glass industry, was of more than ordinary interest, for the Master, Mr. G. Paget Walford, announced a new policy for the Company. He said that he had determined, when entering on his new term of office, that the Company should assume once more its responsibilities to the industry, and bring its prestige and history and influence to the support of all movements devised to promote the industry's interests. With this object he foreshadowed the formation of a reconstruction committee of the Company and a representative gathering of the trade at an early date. The importance of technical training and research as the foundation on which the industry could be successfully rebuilt was emphasised by the presence and the speeches of the Vice-Chancellor and the senior and junior Pro-Chancellors of the University of Sheffield, and also by Dr. W. E. S. Turner, the head of the department of glass technology, who, in addition, gave some encouraging statistics of the growth of new branches of the glass industry. A letter from Mr. H. A. L. Fisher, Minister of Education, apologising for non-attendance, also strongly urged the claims of technical education and its application to the glass trades.

THE Dodman headland on the Cornish coast has been secured for the National Trust for Places of Historic Interest or Natural Beauty. The donor prefers to remain anonymous.

THE expedition to Barbados and Antigua of a party from the State University of Iowa has returned safely and with good results. The object was not only to secure collections in marine zoology, entomology, and geology from a region in which little work had hitherto been done, but also to study the living forms in and around the islands visited and thus to supplement the future more intensive work based on the collections secured. A number of reports are to be prepared; that on Mollusca by J. B. Henderson, the reef fishes by Dr. B. W. Evermann, and the Asteroidea and Holothuroidea by Prof. W. K. Fisher. The Hydroida and Alcyonaria will probably be dealt with by Prof. C. C. Nutting.

SIR JAMES FRAZER in "The Golden Bough" has collected numerous accounts of the deification of kings and priests. The Sumerian people of the dynasty of Ur (2475–2358 B.C.) developed this phase of religion to an extent almost unparalleled in the subsequent history of mankind. By them this belief was connected with a fundamental doctrine of ancient civilisation, the conception of a dying god, Tammuz, the soul of vegetation. The *Museum Journal* for September, 1917, lately received, publishes a series of hymns devoted to the cult of Dungi, the first of these men-gods, found in the Nippur Library. This song-service describes the miseries of life and the solicitude of the man-saviour who intercedes to propitiate the wrath of the gods aroused by sin. This new tablet thus occupies a place of peculiar importance in cuneiform literature.

DR. WALTER HOUGH has republished from the Proceedings of the United States National Museum (vol. liv.) an account of the Hopi Indian collections in the museum. This tribe occupies stone-built dwellings in north-eastern Arizona. It was first visited by white men in 1540, and, owing to the isolation of the country, it has preserved to a greater degree than other tribes the arts and customs of the Pueblos. The Hopi live by farming, and the arts in which they are most skilful are weaving, basket-making, and wood-carving, while their proficiency in cookery is widely known among other Indian tribes. The present collections give a vivid picture of their artistic productions and technology. The report is well illustrated by drawings and photographs, and brings together in an interesting way a large amount of information on one of the most remarkable existing Indian tribes.

THE *Brooklyn Museum Quarterly* for July, 1917, only recently received, describes an exhibition of students' work from the various high schools in the city. It consists of models of stage settings, designs, and drawings illustrating the scenic art of the theatre. During the past century the art of scene-painting has held, in the estimation of the public, a position between that of the mural and that of the sign painter, in spite of the fact that during the eighteenth century the art was highly developed in Italy and France. Among the most interesting exhibits are four scenes designed for the recent production of "The Canterbury Pilgrims" at the Metropolitan Opera House in Brooklyn, and those for "Giaconda" and "The Willow Tree." These settings are designed to assist the actor in realising the "atmosphere" of the piece which he is engaged in representing, and to initiate new developments of character. The scheme is interesting, and suggests new developments in art teaching.

MR. J. REID MOIR, in a contribution reprinted from the *East Anglian Daily Times* of September 17, describes an interesting addition to the collections of the Ipswich Museum, which already possesses a fine series of stone weapons. The casts recently purchased are exact copies, both in colour and form, of the most notable discoveries of ancient human bones which have been made both in this country and on the continent of Europe. One cast represents the strange ape-man (*Pithecanthropus erectus*) of Java, others the Heidelberg jaw (*Homo heidelbergensis*), the Piltdown skull and jaw (*Eoanthropus dawsoni*), the Galley Hill skull and jaw, two examples of *Homo neanderthalensis*, and the famous Cro Magnon skull and jaw. So far as is known, this is the only collection of the kind in Great Britain, and it deserves the attention of anthropologists.

A CRITICAL survey of what is known of the sense of hearing in fishes appears in the Proceedings of the American Philosophical Society (vol. lvii., No. 2). The author, Prof. G. H. Parker, after a careful study of the literature of the subject, considers it probable that in the ears of the higher fishes, where utriculus and sacculus are well differentiated, the sacculus has to do with hearing and the utriculus with equilibrium. The sense of hearing is, however, of a very limited kind, amounting to little more than a bare ability to distinguish sound. The ears of the lower fishes are of a more primitive type, and are probably responsive only to relatively loud noises, such as have been shown to be effective stimuli for the skin.

PROF. I. IKEDA and Mr. Y. Ozaki give an interesting account (Journ. Coll. Sci., Imp. Univ., Tokyo, vol. xl., art. 6, 1918) of the structure and conjugation of *Boveria labialis*, a new species of ciliate protozoon found living in the respiratory trees of two Japanese Holothurians (sea-cucumbers). Each Boveria has a meganucleus and, near its aboral end, one micronucleus. Conjugation occurs periodically, and hence, if this process is taking place at all, the majority of individuals in the same host are in conjugation. The conjugation differs in several remarkable features from the well-known corresponding process in Paramœcium. The two conjugants, which are similar (isogamous), become attached to each other by their aboral ends, and the meganucleus does not disappear, but persists throughout and subsequent to the conjugation. The micronucleus of each conjugant undergoes two successive divisions, the first amitotic and the second mitotic; of the four nuclei so produced, three degenerate and disappear, while the fourth divides mitotically into two—a stationary nucleus and a migratory nucleus. The migratory nucleus of one conjugant passes over to and fuses with the stationary nucleus of the other, and the synkaryon so formed in each individual divides twice, giving four nuclei, one of which becomes the new micronucleus, while the other three undergo degenerative changes and become incorporated into the persisting meganucleus, but they can be traced in the first and second fissions of the now separated Boverias. The authors record examples with two, three, four, and six meganuclei, but in these cases all the meganuclei except one sooner or later disappear. Encystment of the ciliates in the subepithelial connective tissue of the respiratory trees is also described, but has evidently not been fully traced.

IMPORTANT contributions to the exploration of Labrador by Mr. R. J. Flaherty are described in a paper in the *Geographical Review* for August (vol. vi., No. 2). Mr. Flaherty in 1912 made two crossings of the unknown northern part of the Ungava Peninsula between Hudson Bay and Ungava Bay. The first was eastward by Lake Minto and the Leaf River. Part of this route was traversed by A. P. Low in 1898. The second crossing from east to west was through the unknown heart of the peninsula in about lat. 60° N. Mr. Flaherty followed the Payne and the Povungnituk Rivers, and crossed a barren country almost deserted by the present generation of Eskimo since the herds of caribou moved further south. The only natives encountered on the northern traverse were a small group on the Payne River about thirty miles from the coast. The paper is accompanied by a map of the route surveys on a scale of 1 : 506,880, and a smaller-scale map of the Ungava Peninsula.

IN the Proceedings of the United States National Museum (vol. liv., p. 308, 1918) Prof. T. D. A. Cockerell strengthens his highly interesting determination of the presence of Glossina in the Miocene shales of Colorado. Two new species are described, and the author reviews the living forms and their distribution. Osborn's suggestion that many large Cainozoic mammals in America may have been destroyed by fly-borne parasites is rendered highly probable by the wider range of tsetse-flies now indicated by Prof. Cockerell.

MUCH importance is justly attached to the insect fauna of the Upper Carboniferous strata of Commentry (Allier), and literature on the scattered specimens appears in various lands. It may be well, then, to direct attention to a criticism by Mr. R. J. Tillyard of two of Mr. H. Botton's descriptions of specimens at Bristol (Proc. Linn. Soc. N.S.W., vol. xliii., 1918, p. 123). Mr. Tillyard contributes comparative observations on recent and Permian species from Australia.

MR. LE ROY JEFFERS (*Scientific American*, August 24, 1918) has explored the Great Onyx Cave, which was discovered about two years ago to the north-east of the Mammoth Cave of Kentucky. The most interesting feature is the great development of gypsum, which produces a rich variety of crystalline growths. We have a suspicion that the word "helectites," used for twisted groups, should be written "helictites," from ἑλικτός.

A "GEOLOGICAL Handbook of Northern France" has been prepared by Prof. W. M. Davis for the use of American soldiers in France. The book has been approved by the Geographical Committee of the U.S. National Research Council, and copies are being distributed free to the Army cantonments, etc.

DR. C. FENNER, a graduate of the University of Melbourne, contributed a physiographic paper of unusual interest and importance at the July meeting of the Royal Society of Victoria. The paper deals with the physiography of the whole basin of the Werribee River, which includes the Permo-Carboniferous glacial deposits of the Bacchus March district, known to most geologists. Interesting correlations are made connecting the topographic units of the area with their history and settlement, economic conditions and accessibility, rainfall and water-supply. The rocks of the area include Lower Ordovician sediments, Lower Devonian granitic rocks, Permo-Carboniferous glacial deposits, a mixed Tertiary series comprising older basalts, Tertiary leaf-beds, and newer basalts, while recent alluvium forms the fertile deposits of Bacchus Marsh. The area after peneplanation was subjected to differential uplift in the mid-Tertiary period. After the older basalt was poured out, trough-faulting along east and west lines commenced forming the Ballan "sunk-land," with elevated blocks of the Lerderderg and Brisbane ranges to the north and south. Following the extensive newer basalt outpourings, further faulting, involving a western uplift, formed the Rowsley scarp with a north and south trend; and an east and west fault, with uplift to the north, elevated the Gisborne highlands. Between these elevated blocks the south-eastern part of the area forms the "sunkland" of the Werribee plains. The relations of the older and newer basalts to the various fault-lines are utilised as elements in establishing the ages of the earlier and later faults. The Werribee River with its tributaries, including the Lerderderg River, are younger than the newer basalts, and their courses were established before the later faulting. As a result of the formation of the Rowsley fault scarp the rivers have developed deep gorges cut into the elevated earth-blocks, the Werribee gorge being in places 600 ft. deep, while the Lerderderg gorge, in a region twice elevated, is in places 1000 ft. in depth.

THE Scientific Proceedings of the Royal Dublin Society for June and August contain communications by Mr. R. G. Allen, of the Royal College of Science, Dublin, on the effect of temperature on the electrical resistances of porcelains, red fibre, and a new insulator known as erinoid—a by-product of milk. The porcelains were investigated up to 300° C., and the fibre and erinoid up to 100° C., the results in most cases being checked by the use of the leakage method, the galvanometer, and the megger. Of the porcelains the Portland china and Royal Worcester were found to be the best insulators. On the insulation of some of the samples change of voltage had no effect. On all the effect of rise of temperature was a large decrease of insulating power, the resistivity R following closely the law, $\log R = a/T + b$, where T is temperature on the Absolute scale, and a, b are constants for each sample. Erinoid is not so hygroscopic as red fibre, and the resistivities of both change with temperature according to the above law.

THE *Journal für Gasbeleuchtung* for May 18 last states that the United States produced in 1917 670,000 hectolitres of "solvenaphtha," *i.e.* heavy benzol distilling over at between 160° and 180° C., and from which may be derived 90,000 hectolitres (nearly two million gallons) of toluene by using solvenaphtha in place of oil in water-gas plants. In an industrial trial with the Lowe apparatus, where solvenaphtha was substituted for gas-oil, the production of carburetted gas being 14,000 cubic metres in twenty-four hours, the expenditure of solvenaphtha was two litres per cbm. of gas, the equivalent expenditures of coke and steam being respectively 74 kg. and 60 kg. per 100 cbm. gas, with a temperature of 825° C. at the superheater and 15·5° C. at the condenser outlet. Light oil, condensed and separated by cooling, represented 57 per cent. of the solvenaphtha employed, and it contained 14·5 per cent. of benzene and 23·7 per cent. of toluene, which corresponds with 8·3 per cent. and 13·6 per cent. of the initial quantity of solvenaphtha.

AN account of some interesting studies on the formation of coke, of considerable importance from both the theoretical and practical points of view, is given by G. Charpy and M. Godchot in the *Comptes rendus* of the Paris Academy of Sciences for August 26. Starting with a Brassac coal containing only 11 per cent. of volatile matter and not forming a coherent coke, and a Durham coal with 24 per cent. of volatile matter giving alone a very friable coke, mixtures of these two were carbonised in variable proportions. The crushing strength of the resulting coke varied greatly with the composition of the mixture, first becoming appreciable with 20 per cent. of the Durham coal—24 kg. per sq. cm. with 25 per cent., 45 kg. per sq. cm. with 44 per cent., 80 kg. per sq. cm. with 51 per cent.—and then falling to zero when the proportion of Durham coal was increased by a further 5 per cent. to 56 per cent. This rapid and unexpected variation shows the importance of determining exactly by experiment the best proportion when carbonising mixtures of two coals. The same Brassac coal mixed with pitch in certain proportions also furnished a hard coke, and tar could replace the pitch. Results of high interest were obtained in experiments on the effects of a preliminary heating to a low temperature. With a Durham coal containing 28·1 per cent. of volatile matter, direct carbonisation at 700° C. gave a voluminous, soft, friable coke, and this was also the result if the coal had been submitted to a preliminary distillation at 450° C. for thirty, sixty, or ninety minutes before raising to 700° C. But if the preliminary distillation at 450° C. were carried out for 105, 130, or 150 minutes, further heating at 700° C. gave coherent cokes with strengths of 41, 98, and 25 kg. per sq. cm. respectively. Prolonging the preliminary heating to 450° C. for a further fifteen minutes (165 in all) gave again a pulverulent coke. Thus this coal, completely useless for coking purposes in its natural state, gives a coke of normal quality if about one-third of its volatile matter is removed by a preliminary distillation at 450° C. The authors point out that this unexpected result is difficult to reconcile with current theories as to the cause of coke formation.

WE have received a reprint of an article in *De Natuur* by Mr. J. W. Giltay, of Delft, dealing with Mersenne and his ideas on acoustics. Marin Mersenne (1588–1648), Franciscan friar, friend of Descartes, Gassendi, and Thomas Hobbes, "profond philosophe musicien," according to Constantine Huygens, was, in the opinion of Poggendorff ("Geschichte der Physik," p. 327), not a physicist of the first rank, but remarkable for his active correspondence, which at the time replaced to some extent the scientific journals of our day. Mr. Giltay illustrates Mersenne's ideas by quotations from his two principal works, "Harmonie Vniverselle" (1627) and "Traitez des consonances, des dissonances, des genres, des modes & de la composition" (1635). In spite of the undeveloped state of physical knowledge, the Franciscan sometimes approaches near to our present notions, as in his explanation of beats. At times he is still under the influence of Aristotle, as, when discussing the pendulum and the fall of bodies *in vacuo*, he writes, "l'on ne scait si le vuide est possible, ny s'il est quelque chose de réel." His writings abound in sudden digressions into theology and philosophy, but his interest in music was scientific rather than artistic.

As is generally known, in pre-war times our supplies of glass apparatus for laboratory use were largely obtained from what are at present enemy sources. Now that we are thrown on our own resources, manufacturers in this country have taken steps to meet the demand for such glassware. Measuring instruments, such as burettes, pipettes, flasks, and graduated cylinders, made and calibrated in this country, are obtainable—presumably with no more difficulty than is due just now to questions of priority as regards war requirements. We have recently had an opportunity of inspecting specimens of such laboratory instruments manufactured by Messrs. Gallenkamp and Co., Ltd. A correspondent who has seen them remarks that they are well-made articles, and appear to be quite as suitable for laboratory work as the apparatus formerly obtained. The only suggestion to be made is that the thicker parts of the figures (enclosed between two fine lines) might with advantage be roughened, to make the figures more conspicuous. It may be recalled that, as noted recently in these columns, arrangements have been made by the National Physical Laboratory to test and certify glass measuring instruments sent by manufacturers, so that reliance can be placed on the accuracy of any apparatus thus certified.

IN a recent issue of the *Elektrotechnische Zeitschrift* it was stated that the magnetic properties of nickel-steel caused it to be used by the German Navy for the construction of parts of ships near to the compass in order to prevent variable effects on the compass-field. Anschütz and Co. now write a letter (*Elektrot. Ztschr.*, June 20) to state that this use of nickel-steel is by no means new, and, in fact, is a very costly method of obtaining good "compass-fields," and that the method has been almostly completely discontinued. The compasses are now almost entirely gyroscopic. The use of this type of compass has the further advantage of saving large quantities of nickel, which is so expensive and difficult to obtain.

THE smallest and lightest practical set of portable testing ammeter, voltmeter, and wattmeter has been constructed by the American General Electric Co. According to the *Electrical Review and Western Electrician* (June 15 last), the ammeter and wattmeter are equipped for current capacities up to ·20 amps. The ammeter is of the iron vane type, the voltmeter and wattmeter being dynamometric instruments. All windings are magnetically shielded and a new type of air-damper is fitted, rendering the needle very dead-beat. The weight of the instrument, complete in case, is less than 2 lb.

A RECENT German patent (*Glückauf*, August 3, 1918) describes a process for rendering powdered coal and charcoal insensitive to moisture. Finely ground and well-dried coal or charcoal powder is mixed with finely divided powdered peat, which, before grinding, is dried artificially at not less than 100° C.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF SOLAR PROMINENCES.—A summary of the observations of prominences made at Kodaikanal during the second half of the year 1917 is given by Mr. Evershed in Bulletin No. 58. The mean daily frequency, mean height, and mean extent along the sun's limb were respectively 20·0, 37·5″, and 3·58°, differing but little from the corresponding figures for the first half of the year. There were three principal zones of activity: one about the equator, a mid-latitude zone between ±30° and 40°, and a high-latitude zone between ±70° and 80°. More than half of the nineteen metallic prominences recorded were observed during December, which was also the most active month magnetically. In observations on the disc of the sun, 239 bright reversals of H_α and eighteen dark reversals of D_3 were noted, and photographs of H_α absorption markings were obtained on 117 days. The areas and numbers of the absorption markings showed a large increase on the previous half-year, indicating an increase in the density of the prominences except in the case of those occurring about latitude 60°, which have seldom given evidence of their presence on the disc. The distribution of the markings showed the usual excess on the eastern side of the central meridian.

Details of the observations of prominences made at Catania during 1916 have recently been published by Prof. A. Riccò (*Mem. Soc. Spett. Ital.*, vol. vii., series 2*a*). The mean daily number of prominences was 9·8, the mean height 49″, and the mean extent of base 3·1°. There was a considerable increase in the frequency as compared with 1915.

PARALLAXES OF HELIUM STARS.—The recent determinations at Greenwich of the proper motions of stars down to 9th magnitude in the zone +24° to +32° have been utilised by Sir F. Dyson and Mr. W. G. Thackeray in an investigation of the parallaxes and intrinsic magnitudes of some of the B (helium) stars (Monthly Notices, R.A.S., vol. lxxviii., p. 651). The region studied is that portion of the galaxy intercepted by the zone between 4h. and 8h. R.A. The stars near 6h. have a large parallactic factor almost wholly in declination, and on the assumption that they have no systematic motion other than that due to the sun's motion, the mean parallaxes of B stars of different magnitudes can be calculated. For 113 stars of types B8 and B9, ranging in mean apparent magnitude from 1·78 to 8·46, the mean proper motions in declination range from 0·1770″ to 0·0066″, the mean parallaxes from 0·05″ to 0·02″, and the intrinsic magnitudes (corresponding with the parallax 0·1″) from +0·4 to −0·5. The extension of the investigation to faint stars thus confirms the view that stars of types B8 and B9 have not a great range in absolute luminosity. A similar conclusion is derived from the fainter stars of type A0, the mean intrinsic magnitudes having values ranging from +0·9 to +1·5 for 212 stars of apparent magnitude 5·32 to 8·67.

STELLAR DISTANCES AND SPECTRAL TYPES.—A paper on "The Mean Distances of Stars of Different Spectral Types," by Mr. Shin Hirayama, appears in the *Annales de l'Observ. Astron. de Tokyo*, appendix 7. The purpose of the author is to test Kapteyn's formulæ connecting a star's parallax with its magnitude, spectral type, and proper motion. He uses 322 stars, for which both measured and spectroscopic parallaxes are available; as the latter are wanting for types A and B, he uses van Rhijn's constants for them. For stars of magnitude 4·8 he finds the mean parallax 0·029″ for type M; as the type changes from M through K to G_0 it rises steadily to a maximum of 0·054″, and then falls again as we pass through types F and A, being 0·008″ for type B_5. His values agree with those of Kapteyn for types B_5 and A_0, but for the remaining types they are about twice as great.

ENTOMOLOGICAL RESEARCH IN AUSTRALIA.

MR. R. J. TILLYARD, whose admirable book on "The Biology of Dragonflies" was recently reviewed in NATURE, has made a further contribution of importance to the study of this order of insects in a series of papers on "The Morphology of the Caudal Gills of the Larvæ of Zygopterid Dragonflies," published in the Proceedings of the Linnean Society of New South Wales (vol. xlii., 1917, parts 1 and 3). Zygopterids are the slender-bodied dragonflies, often distinguished as "demoiselles," the larvæ and nymphs of which are provided with three conspicuous appendages, at the hinder end of the body, traversed by branching air-tubes. A careful comparative study of the structure of these organs in various genera and in successive stages of growth has been made by the author, who concludes that the median dorsal gill-plate in these insects is analogous with the telson in Crustacea, while the paired lateral appendages are cerci, and "therefore the true homologues of the uropods of Crustacea." These latter are compared with the filamentous cerci of the well-known stonefly (Perlid) larvæ and nymphs, which they resemble in form in the early stages, becoming more highly specialised as growth proceeds. From his comparative studies Mr. Tillyard is convinced that in the evolution of this group of dragonflies a primitive filamentous condition of the larval telson and cerci was succeeded by the "saccoid" type, which persists in a few genera such as Diphlebia and Neosticta, this by the "triquetro-quadrate" type, found in the Calopteryginæ, where the median gill is trapezoidal and the lateral ones are triangular in cross-section, and this by the specialised "lamellar" type characteristic of the larvæ of the great majority of the group, including the familiar Agrioninæ. The author promises further studies on the physiology of these interesting structures, for although their function is doubtless respiratory, the aquatic larvæ which possess them continue to breathe in some way when artificially deprived of them.

The remarkable insect-fauna of the Australian region has provided material in other orders for Mr. Tillyard's researches. In Tasmania, New South Wales, and New Zealand he has discovered various species of small scorpion-flies (Mecoptera), which he describes (Proc. Linn. Soc., N.S.W., vol. xlii., part 2, 1917) as representing a new family (Nannochoristidæ), with the jaws apparently piercing and suctorial, closely parallel to the condition found in many Diptera, and combining remarkably archaic with specialised characters. In a paper on Permian and Triassic insects from New South Wales (*l.c.*, part 4) Mr. Tillyard describes a closely allied extinct type from the Upper Coal Measures of Newcastle (N.S.W.). Much light on the phylogeny of the Insecta may be expected from such studies in Australian palæontology, and the author gives us (*l.c.*, part 1) an example of this in the type of a new order, the Protomecoptera—"a very remarkable fossil from the Ipswich [Queensland] beds . . . the direct connecting-link between the Palæozoic Palæodictyoptera on one hand, and the recent Mecoptera on the other."

In describing these primitive metabolous insects, and comparing them with Neuroptera, Trichoptera, and Lepidoptera, Mr. Tillyard lays stress on the presence in the Mecoptera and Planipennia of a frenulum or group of wing-coupling bristles, comparable with the well-known organ on the hind-wing of most moths, and argues thence in support of Dr. Handlirsch's contention for a close relationship between all these orders. In a very short but important note (*Entom. News*, vol. xxix., p. 99) Mr. Tillyard points out that a frenulum of simple type is present in those minute primitive moths the Micropterygidæ, which have usually been regarded as devoid of that organ. In thus enforcing evidence for the relationship of archaic members of various orders of insects, the author well justifies his use of the morphological method in entomology. G. H. C.

THE PROMOTION OF TEXTILE INDUSTRIES.[1]

THE Departmental Committee appointed by the Board of Trade to consider the position of the textile trades after the war has presented a most interesting report, which is unanimous except for small details concerning certain tariffs.

The report sets out very clearly the dominant position of the Allied countries in respect of the raw materials of the more important textile trades, and lays special emphasis on the exceptional and powerful position which the British Empire holds with regard to the production in particular of wool, jute, and the finest qualities of cotton. The Committee is particularly insistent that this position must be safeguarded by continuous and systematic *scientific* research on the raw materials to improve production both in quality and yield. A striking illustration is quoted to show how scientific sheep-breeding in Australia has improved the quality of wool clipped per head; whilst special emphasis is laid on the urgent necessity for the systematic and scientific study of the growing of cotton. The fringe of this latter subject has only just been touched, and there are immense possibilities in the production of cotton modified by the grower to suit the user.

The Committee, moreover, advocates scientific research on the fundamental principles underlying the various manufacturing processes of the several textile industries, and it is significant that this Committee, composed mainly of prominent manufacturers, emphasises so strongly its belief that such research will stimulate the development and prosperity of the industries represented on it. Three important lines of inquiry are suggested:

(1) Scientific research in connection with raw materials.

(2) Scientific research in connection with the improvement of processes such as carbonising, carding, spinning, weaving, dyeing, bleaching, printing, and finishing.

(3) Technical investigation with regard to the improvement of machinery.

The machinery and methods of the present day are adapted to suit the various types of textile fibres commonly produced, but it is considered that scientific research in connection with the raw materials will evolve and select special types suited to the products required, and that then the cultivation of these types might be encouraged. In manufactures the discovery of the mercerising process of cotton and the production of artificial silk are quoted as instances to show that great improvements can be effected in existing processes and in the discovery of entirely new ones.

The Committee feels unable to recommend the compulsory adoption of the metric system at the present time so far as the textile trades are concerned. The great British textile trades, more particularly the cotton trade, are so predominant in the world that similar industries in other countries have had, in the main, to follow their lead and accept their technical standards, whilst all the textile machinery used in this country and supplied by British manufacturers to foreign manufacturers is based upon British measures. The yard is the standard of measurement for textile goods in almost all the great markets of the East, of the United States of America, and throughout the British Empire, and the larger proportion of our textile export trade is done with non-metric countries. In fact, it is considered that the adoption of the metric system can be brought about in this country, so far as the textile trades are concerned, only with the full concurrence and co-operation of the whole British Empire and the United States of America.

The report criticises the British system of technical and art education, which, in the opinion of the Committee, has failed to supply the textile industries with a sufficient number of highly trained workers and managers. It is suggested indirectly that the Education Act of 1902 is partly responsible for this, in that the management of the majority of technical schools was then vested in municipal bodies, which are elected for quite different purposes, and rarely prove attractive to local manufacturers—a drawback not corrected by the co-option from outside the local education authorities of manufacturers on school management sub-committees. It is noteworthy that this Committee, composed mainly of large employers, considers that it is urgently necessary to awaken the employers of the textile industry to the value of adequate education, particularly of their higher staffs. R. H. P.

[1] Report of the Departmental Committee appointed by the Board of Trade to consider the Position of the Textile Trades after the War. 1918. (Cd. 9070.) Price 1s. 3d. net.

IRISH SEA PLANKTON.[1]

THE importance of studying the common plankton organisms is shown by Prof. Herdman in his "Spolia Runiana," where, basing his results on more than ten years' systematic collecting and working out of standard plankton hauls in the Irish Sea, he points out how the results depend mainly on the presence of only a few genera and species which appear at certain seasons with great regularity and constitute the bulk of the food supply available in the sea. He therefore makes a careful analysis of the quantitative distribution of the six commonest copepods as representative of the zooplankton, each belonging to a separate genus, and the seven commonest diatom genera as representative of the phytoplankton, and the results show that the seasonal distribution of these forms is remarkably constant. Thus the diatoms have two maxima in the year, the larger in spring, the lesser in autumn, the copepods always increasing after and not with the diatoms, so that their maximum is in the summer. The diatoms are thus the forerunners of the small

[1] "Spolia Runiana." III. "Distribution of Certain Diatoms and Copepoda throughout the Year." By Prof. W. A. Herdman. Journ. Linn. Soc., Botany, vol. xliv., p. 173, 1918, and Zoology, vol. xxxiv., p. 95, 1918.

plankton animals, including the copepods, which feed on the diatoms, the copepods in their turn serving as food for nearly all young fish and certain adults, such as the herring and mackerel.

The maxima of the various genera show much agreement with the records from the English Channel, but the interesting fact is brought out that Skeletonema, a coastal diatom enormously abundant at Kiel and very common in the Channel, is apparently quite rare in the Irish Sea even close to land, whilst it is the commonest form in some of the lochs in the west of Scotland.

The copepods Calanus and Temora, which contain a large amount of oil, occur at times in enormous numbers and form an important food for the herring and mackerel, which follow them in shoals and feed voraciously on them, disappearing when the copepods go. This is a good illustration of the prominent truth brought out by this plankton investigation that, although there is a very large amount of food available in the sea, it is not evenly distributed, and that all animals feeding on the plankton must seek out the food they require. The varying distribution of the plankton is thus the chief cause of the movement and migrations of those animals which feed on it.

In the concluding remarks various theories of the origin of these plankton maxima are discussed, the author inclining to the view that here sunlight plays the most important part, and that increased alkalinity of the sea being due to the reduction of carbon dioxide is the result, and not the cause, of the activity of the plankton.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. F. G. Chandler, of Jesus College, has been awarded the Raymond Horton-Smith prize for his thesis on "Empyema."

LONDON.—A Mitchell studentship of 100*l*. is offered to a graduate having the necessary qualifications to study and investigate some definite feature of business or industrial organisation at home or abroad. Applications will be received by the Academic Registrar not later than December 31 next.

The following are among the public lectures at University College arranged for during the new term:—"Economy of Fuel in Private Households," A. H. Barker, on Wednesday, October 9, at 7 p.m.; "The Scientific Problems of Radio-telegraphy," Prof. J. A. Fleming, on Wednesdays, October 30, November 6, 13, 20, and 27, and December 4, at 5 p.m.; "The Nature and Use of 'Tones' in Chinese and Other Languages," D. Jones, on Monday, October 21, at 5 p.m.; "The Nature of Language," H. E. Palmer, on Thursdays, October 10, 17, 24, and 31, November 7 and 14, at 5 p.m.: "The Problem of International Language" (with special reference to Esperanto and Ido), H. E. Palmer, on Thursdays, November 21 and 28, December 5 and 12, at 5 p.m.; "Wound Shock," Prof. W. M. Bayliss, on Fridays, November 22 and 29, at 5 p.m.; and "French Science" (with lantern illustrations), Prof. H. L. Joly, on Tuesdays, October 22 and 29 and November 5, at 5 p.m.

MR. C. E. ASHFORD, headmaster of the Royal Naval College, Dartmouth, has been appointed Adviser on Education to the Board of Admiralty for the duration of the war, continuing in his former position.

DR. W. M. POLK, late dean of the Medical College of Cornell University, has bequeathed the sum of 1000*l*. to the University for the continuation of the John Metcalf Polk scholarship in medicine.

THE current calendar of the Edinburgh and East of Scotland College of Agriculture, copies of which can be obtained on application to the secretary, 13 George Square, Edinburgh, contains full details of the various available courses of instruction in agriculture, horticulture, and forestry. All the courses of study, it may be noted, are open to women.

THE following lectures have been arranged for delivery at the Royal Sanitary Institute by the Child-Study Society:—Thursday, October 10, "Training the Children for Citizenship in America," Mrs. K. Boulker; Thursday, November 7, "The Girl Guide Movement," Lady Baden-Powell; and Thursday, November 28, "Sight-saving Schools," N. Bishop Harman.

THE Universities Bureau of the British Empire has compiled a handbook of the "Universities of the United Kingdom of Great Britain and Ireland," which the Board of Education has published as No. 33 of its Educational Pamphlets at the price of 9*d*. net. In the spring of 1918 the Council of National Defence of the United States invited the universities of the United Kingdom to send delegates to visit American universities so as to establish relations of co-operation and co-ordination. The present handbook was prepared to place the delegates in a position to supply information about the organisation and resources of the individual universities of the United Kingdom. The descriptions in it relate to normal times, and the figures as to the number of teachers and students are for the last normal session 1913–14. The pamphlet states that inquiries regarding any matters connected with university education may be addressed to the Hon. Secretary of the Bureau at the Imperial Institute, London, S.W.7.

SOCIETIES AND ACADEMIES.

CAPE TOWN.

Royal Society of South Africa, July 17.—Dr. A. Jasper Anderson in the chair.—A. **Ogg**: The electrostatic deflection in a cathode-ray tube. In the ordinary Thomson cathode-ray tube for determining the value of e/m for cathode rays, the irregularity of the electrostatic field near the edges of the charged plates has to be allowed for. It is interesting to find the electrostatic deflection when the rays are projected parallel to the plates, but at some distance from them. Methods for making the calculation were given.—Prof. J. D. F. **Gilchrist**: Note on a disease in the snoek (*Thyrsites atun*). The snoek, one of the most important Cape fishes from an economic point of view, is well known to be found frequently in a "pap" or soft condition. This is attributed by the fishermen to the fact that it has not been properly killed on capture, the consequence being that it struggles about in the bottom of the boat, and, in doing so, bruises the flesh to such an extent as to produce the condition mentioned. This condition may occur a few hours after the fish has been caught, and may quickly become so marked that the whole of the muscles, especially of the back, appear quite soft and liquid. The process is believed to be totally distinct from decay by putrefaction or by softening of the flesh by exposure to the heat of the sun, which also frequently occurs. As it was suspected that this condition might be brought about by the presence and rapid multiplication of some protozoal parasite in the muscles, the diseased tissue was examined microscopically, and after staining with methylene-blue and other reagents the presence of very numerous spore-like bodies was detected. These were all arranged in groups of four, and occasionally, on fixation by heat, long filaments were shot out from them, showing that they were Protozoa belonging to the group of Cnidosporidia, which are known to produce diseased conditions in the muscular and other tissue of fish. The groups of four bodies with filaments suggest the family of the Chloromyxidæ with their four polar capsules, but there is reason for believing that they represent spores, not polar capsules, and, if so, they probably belong to a new form of the Microsporidia.—Ethel M. **Doidge**: Mycological notes. I.

CALCUTTA.

Asiatic Society of Bengal, August 7.—Maude L. **Cleghorn**: A note on the vitality and longevity of silkworm moths during the cold and rainy seasons in Bengal. An account of experiments carried out during the past two years on the vitality and longevity of silkworm moths. It is shown that moths which emerge in December and January live longer, while those bred in the rains and hatched out in August and September exist for only a few days. The results of the experiments, which are shown in tabular form, are compared with Tower's observations on the effect of temperature and moisture on certain Chrysomelid beetles.—Dr. B. **Prashad**: Zoological results of a tour in the Far East. Echiuroids from brackish water, with the description of a new marine species from the Andamans. Three species of the genus Thalassema have already been recorded from brackish water on the coasts of the Bay of Bengal and the Gulf of Siam. The anatomy of these is described in detail, and special attention is paid to the structure of the proboscis, which exhibits certain peculiarities in these forms. A progressive modification can be traced in the three species, probably in connection with life in peculiarly dense mud. A new marine species of the genus from the Andamans is also described.—L. **Chopard**: Zoological results of a tour in the Far East. Les Orthoptères cavernicoles de Birmanie et la Péninsule Malaise. All the Orthoptera at present known from limestone caves in the Malay Peninsula and Burma were discussed, and most of them figured. In this fauna one species of earwig, five species of cockroaches, and seven species of wingless Phasgonuridæ are included.—Dr. N. **Annandale** and Dr. B. **Prashad**: Note on the taxonomic position of the genus Camptoceras, Benson, and *Lithotis japonica*, Preston (*Mollusca pulmonata*). The genus Camptoceras was described by Benson in 1843 to include a remarkable fresh-water mollusc from Rohilkhand; two other species were described by Blanford in 1871 from near Dacca. The genus has not been rediscovered in India, but a species has recently been found in Japan. Particulars are given as to the animal and the radula of this species, and the conclusion is drawn that the genus is allied to Planorbis and belongs to the suborder Basommatophora. The shell, recently described by Preston under the name *Lithotis japonica*, is shown to have no relation to the Indian species of Lithotis, but to be closely allied to Limnæa. A new genus is proposed to include it and the Sumatran species *Limnaea brevispira*, von Martens.

BOOKS RECEIVED.

Equilibrium and Vertigo. By Dr. I. H. Jones. With an Analysis of Pathologic Cases by Dr. L. Fisher. Pp. xv+444. (Philadelphia and London: J. B. Lippincott Co.) 21*s*. net.

The Ledge on Bald Face. By Major C. G. D. Roberts. Pp. 255. (London: Ward, Lock, and Co., Ltd.) 5*s*. net.

Eastern Exploration: Past and Present. By Dr. W. M. Flinders Petrie. Pp. vi+118. (London: Constable and Co., Ltd.) 2*s*. 6*d*. net.

Tri-lingual Artillery Dictionary. By E. S. Hodgson. Vol. i., English–French–Italian. Pp. viii+92. (London: C. Griffin and Co., Ltd.) 5*s*. net.

Modern Fruit-growing. By W. P. Seabrook. Pp. xliii+172. (London: The Lockwood Press.) 4*s*. 6*d*. net.

A Bibliography of Fishes. By B. Dean. Vol. ii. Enlarged and edited by C. R. Eastman. Pp. 702. (New York: American Museum of Natural History.)

Contouring and Map-reading. By B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 2*s*.

Macmillan's Geographical Exercise Books. vii., Physical Geography, with questions. By B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

Annual Chemical Directory of the United States. Second edition. Pp. 534. (Baltimore: Williams and Wilkins Co.) 5 dollars net.

Simplified Method of Tracing Rays through any Optical System of Lenses, Prisms, and Mirrors. By Dr. L. Silberstein. Pp. ix+37. (London: Longmans and Co.) 5*s*. net.

Differential Equations. By Dr. H. Bateman. Pp. xi+306. (London: Longmans and Co.) 16*s*. net.

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

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NOTICE.

In consequence of the greatly increased cost of production it has been found necessary to raise the price of NATURE to 9d. The alteration will take effect beginning with the issue for October 24, from which date the Annual Subscription rates will be as follow:—Inland, £2 . 2 . 0; Foreign, £2 . 5 . 9.

ST. MARTIN'S STREET, LONDON, W.C. 2.

STREATFEILD MEMORIAL LECTURE.

The first of this series of annual lectures will be delivered by Professor W. J. POPE, C.B.E., F.R.S., at the City and Guilds Technical College, Finsbury, on THURSDAY, OCTOBER 17, at 4 p.m. Subject.—The Future of Chemistry. Admission Free. All interested are cordially invited.

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Vice-Chancellor—W. RIPPER, C.H., D.Eng., D.Sc., M.Inst.C.E., J.P.

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SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY.

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The sum of £60 will be allowed for travelling expenses to South Africa and half salary from date of sailing till ar[illegible] Johannesburg.

Members of the Staff have to supervise [illegible] part in evening work.

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Applications in triplicate, stating age, profess[illegible] qualifications, and experience, should, with copies of three recent test[illegible] be sent not later October 14, 1918, to the undersigned, who [illegible] application, will send [illegible] particulars if desired.

[illegible]MERS GUTHRIE & CO., LIMITED, 9 IDOL LAN[illegible] L[illegible]NDON, E.C. 3.

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PROFESSOR OF PHYSICS.

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The Professor is expected to carry on research work.

Appointments are generally restricted to candidates under 35 years of age.

Applications, together with testimonials, should reach the HIGH COMMISSIONER FOR THE UNION OF SOUTH AFRICA, 32 Victoria Street, London, S.W. 1 (from whom further particulars may be obtained), not later than January 1, 1919.

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Form of application and further particulars can be obtained from the PRINCIPAL, Municipal Technical Institute, Romford Road, E. 15.

GEORGE E. HILLEARY, Town Clerk.

Education Department,
West Ham, E. 15.
September 18, 1918.

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Salary in each case according to scale.

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Further particulars may be obtained from the PRINCIPAL, to whom applications should be forwarded as soon as possible and not later than October 18, 1918.

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JNO. ARTHUR PALMER, Secretary of Education.

Council House,
Margaret Street,
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LABORATORY ASSISTANT required at

large Public School. Good wages and facilities for working for a degree. Apply, stating age and experience, to Box 148, c/o NATURE Office.

THURSDAY, OCTOBER 10, 1918.

THE METALLURGY OF ZINC.

The Zinc Industry. By E. A. Smith. ("Monographs on Industrial Chemistry.") Pp. viii + 223. (London: Longmans, Green, and Co., 1918.) Price 10*s.* 6*d.* net.

RATHER more than four years ago an American metallurgist, in opening a discussion on the metallurgy of zinc, said wittily: "It is a time-honoured custom to throw bricks at the zinc man. The accusation is that he has borrowed a lime kiln and a gas retort and part of a sulphuric acid plant, hitched them together, and spent the last fifty years in regarding with holy veneration the reactions which take place in that retort. The copper man who thinks of zinc as something with which copper is adulterated to make brass, and the iron man who regards it as a sort of paint for corrugated sheets, and the lead man whose opinion as to zinc is not fit for publication, have long felt that when two or three of the minor details of their respective metallurgies were put in order, they would take a few days and fix up zinc on a modern basis."

It is true that there have been no such spectacular changes in the metallurgy of this metal as were wrought in that of steel and copper by the introduction of converters. Nevertheless, it is quite untrue to state, as is sometimes done, that there has been no change in its metallurgy since the first Belgian furnaces were built in the early part of last century. The main reason why there has been no revolutionary change is that the chemistry of zinc differs radically from that of the other metals, and that these differences control the type of apparatus that can be used.

In the first place, the temperature at which this metal is reduced by carbon from its oxide is considerably above its boiling-point under atmospheric pressure. It is, therefore, always produced as a vapour. In the second place, in order to obtain a merchantable product this vapour must be condensed at a temperature considerably above the melting-point of the metal. In practice, the temperature-range is from about 900° to 415° C. Above 900° C. the vapour is not condensed at all; below 415° C. it freezes to a powder consisting of finely divided metal with between 6 and 10 per cent. of oxide. More than this, the temperature necessary to condense the zinc as a liquid depends on the concentration of the vapour, and is lower the more dilute it is. Consequently the temperature of the condenser must be near that of the boiling-point of the metal at the end attached to the retort and very much lower at the opposite end. In the third place, the metal-vapour is extremely susceptible to oxidising influences, *e.g.* air, water-vapour, and even carbon dioxide. The charge must therefore at all stages contain a large excess of carbon, since the presence of even 0·25 per cent. of carbon dioxide is sufficient to oxidise the metal in this condition; moreover, the volume of gas carrying the zinc must be kept as small as possible. No other common industrial metal presents this combination of characteristics, which makes its smelting a by no means straightforward operation.

These and many other matters connected with the zinc industry are well set forth in Mr. E. A. Smith's book on the subject, which may be warmly commended to readers as giving, in the author's words, "a general survey of the development of the zinc industry and its present and possible future position in relation to the various metal industries of this country." In spite of the fact that the art of zinc extraction has been carried on in Great Britain for at least 150 years, its literature is very scanty, and Mr. Smith's book is therefore particularly timely, especially when it is remembered how gravely imperilled was the manufacture of certain munitions of war in this country by the cutting off of zinc supplies in 1914. Mr. Smith deals successively with the rise and development of the industry in various centres of production, the sources of supply and marketing of the zinc ores, their smelting and other methods of extraction—electrothermal and electrolytic—the properties of the metal and its industrial applications as such and in the form of alloys, its commercial compounds and pigments, and, finally, with the future of the industry in this country. As he points out, British smelters in the last forty years have lagged far behind their rivals in Germany and Belgium. The latter have greatly improved their practice, not only by getting increased extractions from the ore, but also by reducing costs in fuel, retorts, and labour, and this superiority has reflected itself in the value of their shares as compared with those of British companies.

Mr. Smith's book is well written, well balanced, and accurate. Considering how much work has been done in recent years to render the electrolytic production of zinc a commercial success, he might with advantage have devoted more than six pages to this aspect of the industry, but this appears to the writer the only blemish in a very admirable and valuable book. H. C. H. C.

THE NATURE OF SOLUTION.

The Nature of Solution. By Prof. Harry C. Jones. With a Biographical Sketch by Prof. E. E. Reid and Tributes by Profs. Arrhenius, Ostwald, and Woodward. Pp. xxiii + 380. (London: Constable and Co., Ltd., 1917.) Price 12*s.* 6*d.* net.

THE late Prof. H. C. Jones's book on "The Nature of Solution" represents undoubtedly his best and ripest work. The scope and outlook of the book are almost unexpectedly wide, in view of the somewhat closely specialised character of the author's own researches and of the enormous mass of detail which the generosity of the Carnegie Institution enabled him to pile up in connection with some three or four problems relating to the nature of solution. All this mass of reiterated detail, which compelled him to publish from time to time papers summarising the results of other papers, has been left behind in the present book, and the whole treatment of the subject is broad and satisfying. It is particularly refreshing to find in a book written by a pupil of Arrhenius and Ostwald that the English work of Prof. H. B. Baker, by which the vital influence of moisture on chemical change has been brought out in so picturesque and striking a form, receives (probably for the first time in a text-book of physical chemistry) something like adequate treatment. The author was undoubtedly right, however, in putting these classical experiments in the forefront of his argument when seeking to justify the great stress that has been laid upon the condition of solution by so many workers in physical science. The work of Prof. Jones's colleague, Prof. Morse, on "The Osmotic Pressure of Solutions" finds a natural place in this volume, and the principal results of this investigation are quoted.

The principal features of the theory of electrolytic dissociation are described, but as the special work of the author dealt largely with the existence of hydrates in solution, the naked ion of the original theory is less conspicuous than is customary, and more than usual recognition is given to the part played by the solvent in electrolysis. There is also an important chapter on colloidal solution, in which a good account is given of the current position as regards both theory and practice. A brief chapter on "Solutions in Solids as Solvents" is, on the other hand, both inadequate and misleading: the formation of fusible alloys is quoted, without any evidence whatever, as an example of this type of solution. The whole effect of the chapter is to show that the author did not attempt to keep in touch either with crystallography, *i.e.* with the physical chemistry of solids, or with the scientific side of metallurgy, which affords so many and such valuable illustrations of the application of physico-chemical theory. The author's summary in the final clauses of this chapter—that "our knowledge both of pure solids and of solid solutions is very meagre. We have just scratched the surface, so to speak, of matter in the solid state"—is singularly inappropriate, in view of the work of Moseley and of Bragg, which has given us a knowledge of the solid state that is in many respects more exact and more detailed than our knowledge of solutions even after more than 100 years of controversy. This aspect of the theory of solution is, however, really outside the scope of the author's work and interest, and its virtual omission is not a serious fault in a book avowedly concerned in the main with the more ordinary type of liquid solution, and giving an excellent account of this important subject. T. M. L.

THE FUTURE OF THE SEA FISHERIES.

Fisheries of the North Sea. By Neal Green. Pp. vii + 178. (London: Methuen and Co., Ltd., 1918.) Price 4*s.* 6*d.* net.

MR. GREEN'S book is a very plainly written and (generally) a very accurate, short account of the British sea fisheries: it is quite the best of the modern works on the subject of which it treats. One may regard it as an attempt to anticipate the future by considering the present tendencies, and also by contrasting State administration here with that of France, the United States, and Germany. Political developments are noticed and their possible effects discussed: the Empire resources development schemes and the expected economic boycott of Germany are policies which the author regards as short-sighted and likely to be disastrous to us. The former proposals he describes as "impracticable and unjust," and the latter, he expects, will end in a great expansion of the fishery marines of both Norway and Germany, and the depreciation of the British herring fisheries: these theses are very well argued. Fishery organisation in foreign countries is described succinctly and rather to the disadvantage of France and Great Britain. "The administration of the fishing industry by the Norwegian Government is the best organised and most intelligent of all European countries." "More than any other country, France protects and subsidises the fishing industry in order to provide a naval reserve . . . the constant interference of the Government may be said to be the chief cause of the unprogressive spirit among the workers." America, Canada, and Japan have a chapter to themselves, and a picture of astonishing energy and progress is presented.

The contrast that is thus suggested is rather disheartening: "To-day scientific research in our fisheries is almost entirely absent; it is, in fact, probable that there are not three chemists employed in the whole industry; little is known of the food values of different fishes or the constituents of the by-products, or the most efficient and economical processes whereby the fullest advantage can be obtained from those values." The only big fish-preservation industry in Great Britain, that of the salt-cure of herrings, employs a process which has scarcely been modified throughout four centuries; the English industry of fish-canning is almost infinitesimal compared with that of America, and Germany, before the war, bought our fresh herrings greedily and built up a fish-preservation trade worth five millions a year. "At present there is not [in Great Britain] a single million-pound business engaged in the industry. There is far more capital engaged in the manufacture of soap than is used in the exploitation of the British fisheries." All this is a picture of the condition of business enterprise and administration and scientific research which is very unlike that usually placed before the public, and Mr. Green's book is the more interesting on that account. J. J.

THE BASIS OF MENTAL AND NERVOUS DISORDERS.

The Neurotic Constitution. Outlines of a Comparative Individualistic Psychology and Psychotherapy. By Dr. A. Adler. Translated by Dr. B. Glueck and Dr. J. E. Lind. Pp. xxiii + 456. (London: Kegan Paul and Co., Ltd., 1918.) Price 16*s.* net.

THE views of Dr. Adler, though expressed at length, lose in definition by being seen through the rather irregularly refracting medium of the present English translation. To the author, the various traits of the neurotic constitution appear as formulations of what he terms the "masculine protest." The causal factor in this protest, which can be made either by the male or the female, is a feeling of inferiority. A continual attempt is made by the neurotic to dispel this feeling by ordering every detail of his life so that he may find that subjective security of which the feeling of inferiority has robbed him. This compensatory product, this aggressive endeavour at every point to achieve the "maximation of his ego," foredoomed to failure because of its false direction, exhibits itself in its protean forms as the psychoneurosis or psychosis.

Dr. Adler differs from many other workers in the field of psychoanalysis in that he attempts to attribute this lowered self-esteem to a definite inferiority of some bodily organ, and thus to give a physical basis for his psychological theory. The evidence for this view has been offered in a previous work, "Studie über Minderwertigkeit von Organen," which is now being translated into English.

While welcoming this tendency to broaden the general explanatory basis of mental and nervous disorders of this type by an attempt to conceive physiological as well as psychological factors underlying them, one is inclined to think that Dr. Adler's addition of a second supporting pillar to his theoretical structure has been accompanied by an undue attenuation of the first. Freud has laid enormous stress upon the importance of the sex instinct in the production of the psychoneuroses: Adler, his former pupil, ascribes a similarly exclusive *rôle* to the instinct of self-assertion. The writings of Jung, on the other hand, allow of the interpretation that each and every one of the instincts in man may play its part in the causation and continuance of these disorders. To believe that both Adler and Freud have over-stated their cases is compatible with the opinion that a comparison of such views, too sharply focussed as they may be, will add to the physician's power for helping that unfortunate, all-too-human being, the neurotic.

FOOD AND HEALTH.

(1) *The Art of Health.* By Prof. J. Long. Pp. xi+192. (London: Chapman and Hall, Ltd., 1918.) Price 5*s*. net.

(2) *Cookery under Rations. Over 200 War-time Recipes.* By M. M. Mitchell. Pp. 65. (London: Longmans, Green, and Co., 1918.) Price 2*s*. net.

(1) THE author of this book is "persuaded that most of our bodily troubles and the diseases of the vital organs are the result of impurities which are produced or deposited in the system from the foods we consume." It is not surprising, therefore, that his advice to those who wish to maintain or recover health deals largely with matters of diet. In the fifteen chapters of which the work consists only three are devoted to matters other than food—namely, No. 10 on "Water," No. 11 on "Air," and No. 12 on "Climate and Temperature." Even water and air are claimed to be foods.

Two reasons are given for undertaking the work—namely, that the author has been a life student of the breeding and feeding of domestic animals, and that he has been led to study the nutrition of the human body by having suffered for a period of four years from a disorder of his own digestive organs, whereby he was reduced to a mental and physical wreck. In consequence, the public is treated to a dissertation on foods containing some useful maxims of a general nature, for the most part repeated several times throughout its pages. The chief points made are that insufficient attention is paid to the minerals and life in plants, also that too much meat is consumed. The author therefore recommends a diet almost entirely vegetarian, and lays special stress on the use of salads and raw fruits. For this a quaint reason reiterated many times is assigned—namely, that "they maintain a clean digestive track [*sic*] throughout the entire system." Nevertheless, the best section of the book is that which deals with salads. It would be even more useful if detailed recipes had been given. Prof. Long would in no circumstances allow entrails to be eaten, and believes that all kinds of meat cause a craving for drink, both non-intoxicating and intoxicating, whereas vegetables have not this effect. He recommends a vegetable and fruit diet for the cure of inebriates, also for cancer and tuberculosis. Cane-sugar is likewise strongly condemned owing to its "high property of fermentation." Nevertheless, the ration of this sugar which he allows would nowadays be considered very liberal—namely, 2 to 5 oz. per day, according to age and constitution.

It is admitted that there are possible objections to vegetarianism—namely, bulkiness of the food, possible irritation caused by a high proportion of indigestible residue, and the difficulty of obtaining sufficient nitrogen to cover wear-and-tear.

A considerable number of mis-statements are to be found, some of which appear to be based on misconceptions. Thus "heat and energy" is an expression which frequently occurs. It is stated on p. 67 that "the liver, kidneys, lungs, pancreas, stomach, and intestines consist of muscular tissue to which more or less fat is attached." The word "ilium" is used instead of "ileum" for the third section of the small intestine. Fat is said to produce heat at more than twice the *rate* of the carbohydrates. The loss entailed by boiling vegetables is, as a rule, placed too high. Parsnips (p. 35) are said to lose more than one-half of the total digestible food they contain; and in a more detailed statement (p. 40) the nutritive matter is said to be reduced by boiling: in the parsnip from 15 to $3\frac{1}{2}$ per cent.; in the carrot from 10 to 4 per cent.; in the turnip from 6 to $1\frac{1}{2}$ per cent.; in the beet from 11 to $3\frac{1}{2}$ per cent.; and in the potato 20 per cent. Probably the author means that a reduction of the nutritive matter takes place, varying in the parsnip from 15 to $3\frac{1}{2}$ per cent., and so with the others. But the statement is not clear, and, taken with that on p. 35, is calculated to give a wrong impression.

The whole of the useful information in the book could without difficulty be given in a pamphlet one-tenth its size. No index is provided; had it been, the amount of needless repetition would have been made evident at a glance.

(2) For some time after the introduction of rations housewives found it difficult to adapt their cookery to the new conditions. The recipes compiled by Miss Mitchell are intended to help in this matter, and are well adapted to do so. After some useful points on economy in the use of fuel and in making the most of fat in cooking, the recipes proper are given in detail. These are grouped into recipes for (1) meat dishes, more than forty in number; (2) vegetables and sundries, seventeen in number; (3) other meatless dishes, numbering no fewer than sixty; (4) soups, ten; (5) fish, eighteen; (6) sauces, eight; (7) salads, seven; (8) pastry and batters, eleven; (9) puddings and sweets, thirteen; (10) bread and cakes, thirteen; (11) preserves, fifteen.

A mere list does not, however, convey an adequate idea of the value of the book. The recipes are all carefully selected by a writer having practical experience of her subject, and are in most cases excellent.

OUR BOOKSHELF.

Applied Bacteriology: Studies and Reviews of some Present-day Problems for the Laboratory Worker, the Clinician, and the Administrator. Edited by Dr. C. H. Browning. Pp. xvi+291. (London: H. Frowde and Hodder and Stoughton, 1918.) Price 7*s.* 6*d.* net.

THIS book comprises an account of research work on bacteriological subjects by Dr. Browning and co-workers, carried out partly in the Pathological Department of the University and Western Infirmary, Glasgow, and partly in the Bland Sutton Institute of Pathology of the Middlesex Hospital. Much of the matter included has already appeared in the form of separate published papers, but these have been added to and extended.

Dr. Browning contributes an introduction on the scope of applied bacteriology, in which he emphasises that the best results can be attained only by highly trained and experienced workers who have a large part of their time free for original research. Then follow the series of papers the subjects of which include the diagnosis of "enterica" infections (typhoid and paratyphoid fevers and dysentery) by bacteriological and serological methods, by Drs. Browning, Mackie, and Thornton; the use of calibrated pipettes in serological work, by Dr. Browning; observations on the diphtheria group of organisms and on the isolation of *B. diphtheriae* by means of a medium containing telluric acid, by Dr. J. F. Smith; studies on antiseptics, with special reference to selective inhibitory action, by Drs. Browning, Gilmour, and Gulbrausen, in which the action of the flavines and other aniline dyes is considered; and the use of ultra-violet radiations as a means of discriminating between, and of isolating, certain micro-organisms, by Drs. Browning and Russ. The final paper is a summary of what is known about tetanus, by Dr. Browning. This subject is of so much importance in connection with the war that this epitome is very welcome.

Being largely a reprint of research work, the value of this volume can scarcely be appraised at present, but it may be said that much of the matter forms a notable contribution to the advancement of bacteriological science. R. T. H.

Veterinary Post-Mortem Technic. By Prof. W. J. Crocker. Pp. xiv+233. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 16*s.* net.

A BOOK of this type has long been needed to fill a gap in veterinary literature. So far as we are aware, there has previously been no work detailing in a systematic manner the making of post-mortem examinations on the lower animals, and, consequently, reports of autopsies have been lacking in uniformity, and often the most important features have been omitted or insufficiently emphasised owing to the lack of system. Prof. Crocker's book will go far to remedy that state of affairs, and should be in the hands of all students and most practitioners of veterinary pathology. As might be expected, there are several minor points with which we are not in entire agreement. For example, it is suggested that in the case of a small animal suspected of rabies the head severed from the body as close to the trunk as possible should be dispatched to the laboratory for examination. In our opinion it would be far better to send the whole body without mutilation—the extra weight of a small animal is of no importance. The author recommends the use of Müller's fluid for preserving tissues; it would have been better if the formula had been included. He also recommends the use of slat platforms to be used on the floor of the autopsy room. Wood, however, is not an ideal material for use under these conditions, owing to the difficulty of disinfection, which can be properly carried out only by burning, thus causing continual expense. With regard to the examination of the various organs, we are of opinion that insufficient attention is paid to the examination of the various lymphatic glands, which are of paramount importance in post-mortem examinations in numerous affections.

As a whole the book has been written in a very clear and lucid manner, and there is little fault to find with it. The photographic illustrations of the various methods of procedure are excellent.

Common Beetles and Spiders, and How to Identify Them. By S. N. Sedgwick. Pp. 62. (London: Charles H. Kelly, n.d.) Price 1*s.* 6*d.* net.

IN this little volume the author treats, in a style necessarily sketchy and incomplete, of some common British beetles and spiders. In dealing with either group he gives first a short general account of structure and habits, next an outline classification of tribes or families, and then a list of some common species with characteristics so superficially described that the promise "How to Identify Them" contained in the title cannot be considered as fulfilled. The 228 beetles chosen for listing are illustrated by natural-size photographs, most of which are too obscure to be of use. The larger photographs of some selected spiders, supplemented by four plates of outline drawings, are less unsatisfactory, but the front-view portrait on p. 50 lettered "Wolf-spider" is evidently taken from a jumping-spider (Salticid). The classification and nomenclature adopted for both spiders and beetles are those of the naturalists of fifty years ago.

Canning and Bottling, with Notes on other Simple Methods of Preserving Fruit and Vegetables. By Dr. H. P. Goodrich. With an Introduction by Prof. Frederick Keeble. Pp. x+70. (London: Longmans, Green, and Co., 1918.) Price 2s.

IN spite of its modest size, this book contains a great deal of valuable information on bottling, canning, pulping, drying, and salting vegetables and fruit. In the first part of the book the author describes fully practical methods, while in the second part a brief account of the behaviour of bacteria and fungi, the micro-organisms which have to be fought by the preserver of fruit and vegetables, is given. The canning of fruit, which is extremely popular in America, but comparatively little used by amateurs in this country, is warmly recommended in regard both to the flavour and quality of the products and to the rapidity and simplicity with which the work can be carried out. The fear of tin and of ptomaine poisoning, which has prevented some people from canning vegetables, is shown to be entirely groundless.

The Stars, and How to Identify Them. By E. Walter Maunder. Pp. 64. (London: Charles H. Kelly, n.d.)

THE war has renewed interest in the constellations as guides for night-marching, etc., and several handbooks have been published for this purpose. Mr. Maunder gives here in a condensed form much of the information contained in his "Astronomy of the Bible" and his numerous papers on early Babylonian astronomy.

The constellations of the entire celestial sphere are shown in twenty-six clearly printed maps; the constellation figures are not drawn, but the stars of each group are connected by thin lines, which in many cases give some rough idea of the object the name of which it bears. A summary of the ancient myths relating to the grouping of the constellations is given, as affording a useful aid to the memory regarding their mutual configuration. Four northern and one southern key maps indicate the positions of the constellations at the various seasons.

ANDREW C. D. CROMMELIN.

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.]*

Observations of Nova Aquilæ in India.

IN NATURE of June 13 I note that the earliest observation of Nova Aquilæ in England was made by Miss Grace Cook at 9.30 G.M.T. on June 8, and the magnitude was estimated as equal to Altair. In India the star was seen and recognised as a nova about five hours earlier by Mr. G. N. Bower in Madras, who has sent me his original notes made at 10 p.m. Indian Standard Time on June 8 (corresponding with 4.30 p.m. G.M.T.). Mr. Bower was occupied in pointing out the principal stars and constellations to a friend, and identifying them with the aid of Mrs. Evershed's "Guide to the Southern Stars." Turning to the eastern sky, he at once saw a star on the borders of Aquila and Serpens which he could not place. It appeared to be as bright as Altair, or possibly brighter, but not so bright or white as Vega. Altair was, however, unfavourably placed for the comparison.

At Jhelum, North India, the star was independently discovered on June 9, 3.30 a.m. I.S.T. (10 p.m., June 8, G.M.T.), by Mr. C. L. Dundas, I.C.S., who kindly advised me by telegram of his observation. He also estimated it as equal to Altair, but at the same time on the following night "it was apparently equal to Vega."

At Kodaikanal I was photographing the spectrum of Venus on the morning of June 8, and can state with some confidence that the nova had not then appeared, or perhaps it would be safer to say that it had not risen above the second magnitude. The sky was exceptionally clear that morning, and the brilliance of the Milky Way attracted special attention between 4 a.m. and dawn, about an hour later. Mrs. Evershed and myself were both observing the Milky Way, and both had the possibility of detecting novæ at the back of our minds. This narrows down the time of the outburst to between 11 p.m. G.M.T. on June 7 and 4 p.m. G.M.T. June 8.

The spectrum of the nova has been studied here in some detail, thanks to the partial failure of the monsoon in Southern India, which resulted in a good number of fairly clear nights from early in June to the middle of July. Two series of spectrum photographs were obtained simultaneously—a large-scale series with a 6-in. prismatic camera, and a small-scale series with a 2-in. prismatic camera, the latter showing considerable extension in the ultra-violet. By a special arrangement of the apparatus I was able to photograph a comparison spectrum of Arcturus accurately aligned with the nova, so that the wavelengths in the nova spectrum have been determined by reference to the lines in Arcturus.

On the nights of June 12–13 and 13–14 many of the absorption lines in the nova appeared to be in duplicate, and there are two series of hydrogen absorption lines, both enormously displaced towards violet; the wider, more refrangible series in Hβ, Hγ, and Hδ gives a mean displacement corresponding with 2700 km./sec., whilst the comparatively narrow, less refrangible series gives 1720 km./sec., both in the direction of approach. This is with reference to Arcturus, and uncorrected for the component of the earth's motion, which is very small. In later plates the more refrangible set of lines has vanished, whilst the less refrangible set shows a slightly increased velocity, which on the night of June 19–20 was estimated at 1860 km./sec. This accelerating motion reminds one of eruptive prominences ejected from the sun, and, if confirmed, would indicate the action of a repulsive force.

The hydrogen emission bands are very intense and well defined in all the photographs, especially $H\alpha$ and $H\beta$, but in the ultra-violet beyond $H\delta$ they become feeble and difficult to distinguish, whilst the absorption lines are strongest and persist longest in the ultra-violet, where they have been photographed up to $H\pi$ on June 18–19. The $H\alpha$ line stands out isolated and without absorption in all the plates except the earliest one exposed on June 13–14. On this plate the continuous spectrum is faintly visible near it, and the two displaced absorption lines corresponding with the two velocities mentioned above are clearly shown. The $H\beta$ emission band on June 20 extends from λ 4834 to λ 4885, and within it are three maxima at 4857, 4864, and 4880.

The last plate secured was exposed on July 11, the star being then of magnitude 3·6. This photograph shows emission bands only, extending to $H\eta$, and there is no appreciable absorption, even in the ultra-violet. The nebula emission band at 5007 has greatly increased in relative brightness, in accordance with precedent.

Kodaikanal, August 6. J. Evershed.

THE "TAYLOR" SYSTEM OF "SCIENTIFIC MANAGEMENT."

During the last year or two much attention has been given to the results of analyses of industrial operations obtained by Dr. F. W. Taylor in the United States, and a system of scientific management has been based upon them. Advocates of the "Taylor" system claim that, by the thorough analysis and investigation of the actual practice of manufacture, it has been possible to deduce certain principles applicable to all industry. These principles are not so co-ordinated and developed as the laws of physical science, because, although the result of industry—the production of concrete material things—is physical, the actual process of production by human brains and hands is not a physical, but a social, process. Only those who maintain that social laws cannot be discovered which will explain and govern the actions of society can consistently argue that the "Taylor" principles applied to industry are not scientific.

In the early days of mechanical invention progress was entirely by trial and error. At the present day almost all invention is the result of laborious investigation and research, and the development of invention and design has been greatly accelerated by the application of scientific method. The complexity and minuteness of detail shown in the complete working drawings of a modern engineering firm would have been beyond the comprehensions of our forefathers, who could not decide such things on paper, but had to work by rule-of-thumb methods. The application of cience to engineering design has made all this levelopment a matter of course to the present neration. Science has made mo headway in n, because a knowledge of the laws of the strength of materials, and of magnetism and electricity, are essential to the design of steam and electric machines; and once a man is forced to use science as the basis of his work, he is more likely to evolve scientific methods in connection with the numerous details and routine of actual production. In this direction, however, there is still much that can be done, but the fact to realise is that in this field of human effort scientific method is accepted by practically all.

When we come to the actual purchase, storing, and handling of materials required for production, we find no equivalent to the modern scientific designer and draughtsman. We find a varied collection of buyers, storekeepers, and clerks. It is safe to say that very few of these types of workers have the haziest notion of what scientific methods are, or how they could be applied to their work. It is probably unfair to expect this, as they are all highly trained by rule of thumb. Planning and co-operation, which are among the basic principles of scientific management, are usually glaringly absent, and where production is not held up by lack of material, this is accomplished by prodigal expenditure and, consequently, inefficiency in the use of material. Nevertheless, method is accepted in this direction also, without much controversy. It is agreed that works should be built so that they can be easily expanded without mixing up all the departments, and laid out so that material can travel as continuously as possible from one process to another, until completed, with the minimum amount of cross or backward travel. It is agreed that materials should be purchased with some relation to the output, the time required to deliver, and the number of times to be repurchased in the year, so as to guarantee material when required, without at the same time locking up more capital in stocks than is necessary. It is agreed that stores should be large, roomy, and completely closed in, and nothing issued without proper requisition; and that men from the store should move material to the shops so that the time of the skilled men is not wasted seeking after material.

There are hundreds of systems for doing these things—in fact, each firm must evolve the one most suitable for itself; but the principles underlying all these varied systems are the same; and once a manager has a grasp of these principles he can quickly plan a system, and with time and continual care will get it to work. Buyers, storekeepers, and clerks have no scientific training, and, consequently, they seldom see the principles involved. To unscientific minds there is little or no co-ordination or correlation; everything is more or less in watertight compartments; they cannot see the extraordinary interdependence of all sections of industry. As, however, this type of labour is not numerous, and has no organised objection to improved methods, it is possible to improve matters comparatively quickly with a reasonable expenditure of will and mental energy on the part of the management.

The efficient buying, storing, and handling of the raw material of an industry, while they are very important, and will reduce the cost of manufacture, are at best a saving effected on a very small percentage of the total human effort expended in industry. If we realise that everything that man makes is consumed, sooner or later, then we may consider all the products of each industry to be the raw material of another industry. Production we can conceive as the evolution of raw material from a simple to a more and more complex product. Each time it is sold, bought, and stored in the process, we may consider its growth temporarily stopped. It is during this time of lack of change, when the very minimum of human effort is expended on it, that we try to save human effort. During all the numerous definite changes of the product, when the maximum of human effort is expended, we refuse to apply scientific principles. Considering that this is the application of science which affects by far the greatest number of workers, it is very easy to comprehend their opposition to being "Taylorised," as they say.

The "Taylor" method accepts no preconceived ideas of how a job should be done. As a chemist splits up a compound into its elements, so Dr. Taylor says that all jobs should be split up into their elemental operations. These elemental operations are carefully studied and timed by engineer experts, and the useless ones, which we may consider as impurities, are eliminated. The best machine tools and equipment are used, and, therefore, standard minimum times can be found for all standard operations. When data are accumulated giving the time required for standard specified machine work, fitting, etc., then standard operation times can be fixed from the drawings without any timing in the shops, just as the designs themselves may be made without shop experiments. "Time" or "motion" study is scientific in its method, and the accuracy of the result will, like all experimental data, depend on the accuracy of the observer. There are definite principles in this "Taylor" method which, when grasped by experts, can be used by them to arrive at accurate results. All other methods of "rate-setting" are non-scientific. Some are pure guess-work, some are more or less so.

The "fatigue factor," which is the time to be allowed in addition to the "standard" time, so that the worker may not be "fatigued," is most difficult to discover accurately; but for this, science is as much at fault as industry. Medical science formerly concerned itself almost entirely with the cure of disease, but it now devotes itself largely to cause and prevention. When we all realise that disease must be prevented, we shall soon begin to realise that industrial fatigue must also be prevented. The "Taylor" system is the only one that separates out the work and fatigue of production, like the analysis of useful work and losses in a machine. It remains for the scientific experts, the engineers, the doctors, and the psychologists to co-operate and co-ordinate their efforts so as to produce as scientifically accurate a result as their combined efforts make possible, and to keep it continually up-to-date as methods improve and knowledge extends.

Dr. Taylor says that the workers must be instructed in the principles of their art by the management, and not left to learn it from others as they see fit. This necessitates that the management should be organised on a functional basis. Brains must be specialised and trained just the same as manual labour, and, therefore, the system does away with the old orthodox foreman and his assistants and under-assistants, and he creates many foremen, each of whom has one specific function, in which he is an expert. The "Taylor" system separates the functions of planning, instruction, and execution. It increases the cost and the size of the management, and greatly increases its responsibility. That is why so few employers will adopt it. It requires much more care, study, and thought than any arbitrary, non-scientific system.

The trade-unions and the men oppose the system because it will not use individual and trade habits and prejudices unless they happen to be scientifically sound. While this attitude excuses the workers, it betrays a lack of vision on the part of the "intellectuals" in the Labour movement, who, so far, are unable to see that the elimination of the enormous amount of useless effort put forth by the working classes must be to the benefit of that class more than any other.

It is the same old battle of knowledge against ignorance and prejudice. Patience, sympathy, and much more education are required. Not education which will give to more and more little uncorrelated scraps of chemistry, physics, and electricity, but an education which will train the mind to think in a scientific manner and grasp the significance of the interdependence of all things, and most especially human effort. If we are to maintain our position as one of the greatest of the world-States, intelligently directed effort on the part of everyone will be obligatory. The same energy put into useful work as is now wasted in useless effort will not only double and treble our production of material wealth, but it will also ease the burden on the workers and enable them to live freer, higher, and happier lives.

J. M. Scott-Maxwell.

GERMAN INDUSTRY AFTER THE WAR. III.

MM. JAUREGUY, FROMENT, AND STEPHEN conclude their series of communications to the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (see Nature for September 26 and October 3) on the influence of the war on German industry with some interesting reflections on its after-effects, temporary and permanent. There can be no doubt that the isolation of Germany for so long a period has occasioned profound modifications in her industrial and commercial position. Whatever may be the ultimate result of the struggle, she no longer hopes for the victory on which, at the outset, she confidently reckoned. All her energies are now directed to avert or to minimise the disastrous consequences which await her. The era of peaceful penetration is at an end. She realises that she has incurred a world-wide hatred, and that the world's markets are no longer open to her on pre-war terms. Moreover, she is face to face with an unlooked-for and astonishing development on the part of her most powerful enemies of those industries in which she was supreme, and which she trusts may still enable her to recover, to some extent, her lost position. These industries, indeed, are the main means by which she hopes to get over her immediate financial difficulties, to retrieve her commercial credit, and so enable her to purchase the enormous supplies of raw materials of which she is in urgent need.

A very few months after the outbreak of hostilities the leaders of German industry realised the seriousness of their position, and during the middle of 1915 they began to take steps in order to meet the difficulties in front of them. Political reasons compelled the State to delay for a time any public recognition of their apprehensions, but in the late summer of 1916 the Government created an Imperial Commission to study and report upon what was termed the "Economics of Transition," or, in other words, the most feasible means of passing from the economic life of war to the economic life of peace. The Commission consisted of certain State functionaries with a technical staff composed of qualified representatives of every important branch of German industry. Its duties were to consider the best means of regulating the purchase of foreign material, and, as a consequence, to study the question of exchange, to regulate the transport of the merchandise thus bought—that is, the question of freight—to regulate the distribution of imported raw material, and, lastly, to decide upon the most effective means of recovering over-sea traffic.

The discussion of these questions greatly agitated commercial and industrial circles during 1916 and 1917, and roused many conflicting interests. The difficulty was to determine which industries should receive preferential treatment, for it was obvious that these regulations would inevitably strike at the root of all freedom of commerce. The main ideas which seemed to guide the Commission, acting in the general interests of the State, were to develop as rapidly as possible the exportation of products for which presumably there would be an urgent demand, and which, therefore, were commercially the most valuable, such as synthetic dyes and pharmaceutical products; to prevent all importation of dispensable material; to manufacture as rapidly as possible raw materials into products that might be re-exported with the shortest possible delay; and to import the largest possible quantities of food and forage.

As may be imagined, particul[illegible] industries at once began to urge their right[illegible] preferential treatment. It was practically impossible to settle their claims on any intelligible or rational basis. Moreover, many economists viewed the interference of the bureaucracy in matters of commerce with considerable distrust. The great purchasing organisation which was contemplated foreboded a State monopoly. The regulation of imports and exports seemed to strike at the prosperity of Hamburg and Bremen, and the shipping interest protested. Commercial freedom, they insisted, could alone save the country.

Concurrently with all this unrest there was a growing feeling of dissatisfaction with the working of the numerous war societies which the Government had called into existence and placed under the direction of various Ministers of State. By the middle of 1917 these numbered about 250, and were directed solely to the interests of the Army and the war. They proved exceedingly irksome to the commercial classes as a whole, and were at times of great inconvenience and even hardship to the workers, who were moved about from place to place, like so many pawns in a game, as the necessities of the war seemed to demand. By the end of 1916 the Imperial Chancellor had decreed what was, in fact, a civil mobilisation. Certain industries were forcibly taken over by the State, such as the manufacture of soap and of boots and shoes. In the latter case the tanning and leather industries raised a violent protest, and the reaction—it was virtually a revolution—spread throughout Germany. A syndicate such as was contemplated by the Government would mean the eventual ruin of their export trade. One manufacturer thus expressed himself: "The war has shown how much we as a nation are detested by the foreigner and regarded as barbarians. Merchandise launched upon the world's markets after the war by a State syndicate would meet with the greatest opposition, whereas goods offered by old commercial friends who are known personally, through commercial relations established for years, and are not looked upon as barbarians, would be received in a very different spirit."

The arguments of the traders met with an echo in the Reichstag. The syndicates were warmly defended as provisional measures by ex-Vice-Chancellor Helfferich, and supported by State-Secretary Schwander. Ex-Chancellor Michaelis went even further: they were, he said, a fiscal necessity, and must exist after the war as State monopolies, in view of the enormous financial needs of the Empire. In this declaration the industrial community saw the justification of its fears and the necessity for its action. The opposition was thereby strengthened, and in the end the Government capitulated.

There are two great branches of industry on which Germany sets great store, and which she hopes may do much to rehabilitate her commercial position after the war. The one is the synthetic colour trade and the affiliated manufacture of pharmaceutical products; the other is the potash industry, of which she had practically a monopoly.

As regards the first, she is striving by every means to maintain her ascendancy. Not only have the great colour-producing concerns banded themselves together to work in common and pool their profits, they have also taken steps to assure themselves of a continued and, indeed, increased supply of the trained material upon which the ultimate success and development of their industry depend. This they have sought to further by the establishment of scholarships or bursaries, known as the Liebig bursaries, to be awarded to deserving young chemists who have graduated at the polytechnics, on condition that they serve as assistants to the professors and are trained in the work of research. The necessary capital of 2 million marks to found these bursaries has been entirely subscribed by the leading colour-makers. Similar action has been taken by the Technico-scientific Union, which acts as an intermediary between industry and the scientific departments of the universities and the polytechnics, and arranges for the investigation of special problems which the smaller or less wealthy industrial concerns may desire to have solved. There is also an organisation known as the "Society of Friends and Benefactors of the Rhenish University of Bonn," which seeks to make generally known the knowledge acquired during the war in the domains of agriculture, commerce, and industry, and to further their progress by the active collaboration of science and industry. These instances are remarkable as indicating that Germany is at length seeking to emancipate itself in educational matters from official thraldom. Hitherto efforts of this kind have been largely initiated or controlled by State authority. It is curious that whilst that country as the result of war-experience is moving towards a more democratic control in this matter, our own action in national educational effort as the outcome of the same experience tends more and more towards bureaucratic direction.

The Stassfurt potash deposits are, no doubt, a great German asset. Prof. Ostwald, indeed, has declared that it rests with Germany to decide if in the future the world is to be nourished or starved. Four years' experience will, however, convince most people that the learned professor's assertion is on a par with much of the rodomontade to which he has accustomed us. There are many signs that the German potash monopoly will be broken, and, as Mr. Kenneth Chance has shown in the paper which he read at the recent annual meeting of the Society of Chemical Industry, the production of potash in this country is far from being an insoluble problem. With the passing of Alsace to France, Germany's control of the main supply will be jeopardised. Moreover, there are other untapped sources throughout the world. It has been asserted that the chance of finding soluble potash in British geological deposits is at least as great as that of discovering mineral oil. What is wanted is a systematic scheme of exploration which has never yet been attempted. There is no *a priori* reason why the conditions which have led to the creation of the German deposits should be confined to that country. It seems only yesterday that such deposits were discovered in Alsace, and what has happened in Alsace may well be found to have occurred elsewhere.

DR. HENRY DYER.

WITH the death of Dr. Henry Dyer on September 25, there passes from our midst, at the age of seventy, one whose name will ever be associated with the rise of Japan as an industrial Power. He had barely finished his distinguished student career in the University of Glasgow when, on the recommendation of Prof. Macquorn Rankine, he was appointed principal of the newly constituted Kobu Daigakko or College of Engineering in Tokyo. This was in 1872, when he was only twenty-four years of age. An account of the college in these early days will be found in NATURE, vol. xvi., p. 44 (May, 1877), and its marked success as an educational institution up to the date of its amalgamation in 1886 with the Teikoku Daigaku or Imperial University of Tokyo was an eloquent tribute to the clearness of purpose and the organising skill of its first principal.

In considering the part Dyer played in this great venture we should bear in mind not only his own direct work, but also the remarkable staff of young professors he gathered round him. Most of these he outlived, such as Ayrton, the electrician; Edward Divers, the chemist; John Milne, the seismologist; and C. D. West, the engineer, a man of the wide culture so characteristic of the graduates of Trinity College, Dublin. Prof. John Perry and Prof. Thomas Alexander are still with us, as are also two of the professors of English, the Rev. W. G. Dixon, now of Dunedin, and Prof. J. M. Dixon, of the University of South California, Los Angeles. The inclusion of English as an essential subject of study in the engineering curriculum showed the far-sighted policy of the early organisers of the college. From within its walls there went forth a great body of graduates to whom English was almost a second mother tongue, so well were they trained in the use of our idiom and in the knowledge of our best books. Many of these graduates held important Government posts, and their influence must have been considerable in shaping Japan's destinies.

After ten years of strenuous work Henry Dyer retired from the principalship and settled in Glasgow, where he soon identified himself with progressive educational developments. He threw himself with characteristic ardour into the organisation of what is now the Royal Technical College, of which he was a life governor. He became a member of the Glasgow School Board in 1891, and had acted as chairman since 1914. He was particularly interested in the work of the continuation classes and in the difficult problems of industrial reconstruction and education. As deputy-chairman of the Board of Conciliation and Arbitration of the Manufactured

Steel Trades of the West of Scotland, he enjoyed the confidence of both masters and men. He also took an active interest in the West of Scotland branch of the British Astronomical Association, of which he was honorary vice-president at the time of his death.

In 1910 Dr. Dyer received the honorary degree of LL.D. from the University of Glasgow, and in 1915 the degree of Doctor of Engineering from Japan. In 1882 he was decorated with the Japanese Order of the Rising Sun (Class III.), and a few years later with the Order of the Sacred Treasure (Class II.).

In addition to many contributions to periodical literature, Dr. Dyer wrote a number of important books, of which the best known is "Dai Nippon, the Britain of the East." In this volume he traces the rise and progress of Japan in economics, industries, and education, very naturally devoting considerable attention to the work of his own College of Engineering.

His other published works deal with such questions as science teaching in schools, education and national life, the evolution of history, and the like.

Dr. Dyer's many friends and associates can look back upon the record of a life well spent in the highest educational activities and in furthering the interests of the community among whom he lived. His was a strong personality actuated by a single-hearted enthusiasm in the cause of scientific training.

C. G. K.

NOTES.

We learn with much satisfaction that the report of the death of the distinguished philosopher, M. Emile Boutroux, member of the Institute of France and of the French Academy, is incorrect.

In the *Times* for October 5 there appears a short notice concerning the latest Halberstadt biplane, quoting a report on this machine prepared by the Technical Department of the Air Ministry. It is exceedingly gratifying to read that the performance of the above machine is poor when compared with our own machines of a similar class, especially when it is remembered that the particular aeroplane on which the report is based was captured so late as last June, and bears the date April 14, 1918, stamped on various parts. Some figures relating to speed and climb are given in the *Times*, but, unfortunately, the weight of the machine is not stated, so that their full significance is not apparent. The speed is given as ninety-seven miles an hour at 10,000 ft. with the 180-h.p. Mercédès engine, and the times given for climbs to various heights indicate a climbing speed of about 600 ft. per minute at ground-level. If the weight of the machine were 2700 lb., a likely figure for such an aeroplane, one would expect a climb in the neighbourhood of 1000 ft. per minute at ground-level with the above horse-power, and this rough figure gives some idea of the relative merits of our own two-seater fighters and this recent German machine. The Halberstadt is considered easy to fly and quick in manœuvrability, but these qualities cannot be used to the best advantage in a machine the speed and climb of which are low. The report in question is of great interest, since it establishes in a very di[illegible] manner the superiority of our machines over those of the enemy, and there seems little doubt that this superiority, once definitely gained, will be easily maintained in the future.

The Right Hon. H. A. L. Fisher, President of the Board of Education, will preside at a meeting to be held at the Royal Society of Arts on Monday, October 28, at 3 p.m., when a scheme for the promotion of industrial art will be submitted for consideration. Amongst those who have consented to speak are Lord Leverhulme, Sir Charles Allom, Sir Woodman Burbidge, Mr. Kenneth Lee, Sir William McCormick, Mr. Gordon Selfridge, and Sir Frank Warner. The prime objects of the scheme are:—(1) To encourage and co-ordinate movements towards the development and improvement of industrial art, with the view of maintaining for the trade of the British Empire its position in the markets of the world; (2) to co-operate with Government Departments and other bodies in promoting exhibitions, and in particular with the Government scheme for a British Institute of Industrial Art; and (3) to initiate and encourage research, experimental and other work germane to the objects above indicated, to award grants for conducting such work, and to co-operate, whenever possible, with Government and other institutions founded for such purposes.

An Exhibition of New British and "Key" Industries, organised by the Industrial Section of the Tariff Reform League, was opened at the Central Hall, Westminster, on October 7, and will remain open until October 22, when the intention is to take it to Manchester and other large provincial centres of population. The exhibition is on a smaller scale than that recently organised at King's College by the British Science Guild, to which appreciative reference is made by Mr. H. J. Mackinder in his introduction to the official handbook, and little is included which was not represented in that exhibition. On the scientific side, therefore, there is nothing to record which has not been described already in these columns. Among the exhibits of new or revived British industries are flags, Christmas cards, dolls, toys, puzzles, indoor games, and picture-frame mouldings, which were outside the field of the British Scientific Products Exhibition. The handbook, price 1*s.* net, contains instructive articles upon the occurrence and uses of metals and other substances essential to the existence of many great industries, and controlled by enemy influence before the outbreak of the war. The fact that we were dependent upon Germany for many products and appliances which we were fully capable of manufacturing ourselves is beyond dispute, but it must remain a matter of opinion as to whether the conclusions of the Tariff Reform League as to its chief cause are correct. The exhibition is, however, an enlightening display of national scientific and industrial effort, and as admission is free there will no doubt be many visitors to it.

Dr. Addison, Minister of Reconstruction, in his inaugural address at the opening of the Pharmaceutical Society's School of Pharmacy on Wednesday of last week, laid stress upon the need for co-ordination of scientific knowledge and for a thorough and scientific treatment of facts and inquiries. The greatest danger before and during the war were German organisation, training, and method, especially in the application of physical science; to safeguard ourselves in the future it was necessary to provide better training and better conditions of life. At the outbreak of war we were faced with difficulties consequent upon our dependence on Germany for the supply of a large number of medicinal chemicals, as well as of certain medicinal herbs, and Dr. Addison described the methods by which these difficulties were overcome, with the result that not only did we succeed in satisfying ourselves, but we were also in a position to supply our Allies and to export to certain neutral countries. The particular lesson to be learnt was that we must have a much better supply of trained chemists, and to get this supply and maintain it a sufficient number of well-paid and suitable posts must be assured. Chemical science and industry must be completely reorganised. Science must not be bottled up in laboratories, but given a wider range and more freedom. However, with all that we plan and arrange, we must never forget that our national strength ultimately resides in the vitality, independence, initiative, and character of individual citizens.

THE announcement that within the last few days there has been direct wireless communication between Great Britain and Australia must not be exaggerated into an achievement heralding the immediate approach of direct wireless communication between the two countries. It is unnecessary to point out here that, under certain abnormally favourable conditions combined with an element of luck, signals can be heard over remarkably long distances. On more than one occasion, when such signals have been heard over long distances, the feat has been allowed to become unconsciously exaggerated in the public mind, and the science of wireless telegraphy has not thereby been advanced. It is not the first time that reports have been issued of wireless communication with the Antipodes. During 1917 a wireless operator at Invercargill, New Zealand, is said to have found no difficulty in reading messages transmitted from the Eiffel Tower, in Paris, and Coltano, near the Italian Riviera. Possibly developments have taken place during the war (about which nothing has been said, and very properly too) which are bringing us nearer satisfactory and trustworthy commercial long-distance wireless working over ranges indicated in recent Press announcements. It appears that in Germany, too, the problem of long-range working has been receiving attention. In a recent description of the Nauen station it was stated that the equipment had been so enormously developed during the war that it was now capable of working over a range of 6200 miles. The quiet scientific work essential to the solution of problems that have hitherto made commercial working over very long ranges an impossibility has been practically in abeyance during the war, and until we know what has been accomplished under the veil of secrecy it is wiser not to assume too much from the announcements appearing in the Press.

THE June issue of *The Central*, the journal of the Old Students' Association of the City and Guilds College, contains an article on the organisation of the technical worker. Since, first, the manual workers and, later, the employers have formed unions or associations for their mutual protection, there is a rapidly increasing sentiment amongst technical workers that their interests would be best advanced by the formation of some protective association. The older technical societies do not concern themselves with the material advance of their members, and they have been, on the whole, somewhat slow to act in the interests of the professions they represent during the many changes of the last few years. The question whether scientific and technical workers should form a union is a vexed one, the more so since involved in it is the very difficult subject of the definition of a chemist or an engineer. The chemists have been the first in the field to form a professional union, and two rival bodies are already constituted, the British Association of Chemists and the National Association of Industrial Chemists. In addition, the Institute of Chemistry has increased its activities and made a very proper attempt to open its membership to all genuine chemists—using the term to indicate the fully qualified chemist comparable with the lawyer or the doctor of medicine. Unfortunately, this has failed, and the founders of new organisations have persisted in their formation, although they will not be representative of the properly qualified chemists. The proposed National Union of Scientific Workers has less trouble in deciding the qualifications of candidates for membership, and if it is successful in any way in obtaining recognition of the proper place of scientific work in the national life, it certainly merits support. It is, at any rate, clear that the days of aloofness and isolation, which have been a characteristic of our scientific societies in the past, will have to give way to a spirit of helpful co-operation if the societies are to make their valuable influence felt by the nation.

THE death is announced, on October 2, in his fifty-fifth year, of Mr. John Briggs, principal of University Tutorial College, London.

DR. PERCY KIDD will deliver the Harveian oration at the Royal College of Physicians of London on Friday, October 18, at 4 p.m.

THE first annual Streatfeild memorial lecture will be delivered on Thursday, October 17, at 4 o'clock, at the City and Guilds Technical College, Finsbury, by Prof. W. J. Pope, who will take as his subject "The Future of Chemistry." No charge will be made for admission.

DR. C. ADDISON, Minister of Reconstruction, will give an address on "Principles of Reconstruction" at 4.30 on Wednesday, October 16, in the Saddlers' Hall, Cheapside. The lecture will be the second of the series arranged for by the Industrial Reconstruction Council.

A WAR relief fund for the purpose of restoring the gardens and orchards in France, Belgium, and Serbia which have been destroyed by the enemy has been opened by the Royal Horticultural Society. Sir H. Veitch, the honorary treasurer, will be glad to receive contributions to the fund. They should be sent to him at Room 39, 17 Victoria Street, S.W.1.

CAPT. SIR CHARLES BATHURST, K.B.E., who has been Parliamentary Secretary to the Ministry of Food since the beginning of last year, and has done very valuable service for the promotion of agriculture for many years, has had a peerage of the United Kingdom conferred upon him by the King. It is understood that he will represent the Ministry of Food in the House of Lords.

THE Commitee of the Ramsay Memorial Fund (to which the Italian Government has granted 300*l*. a year for ten years to establish Ramsay memorial fellowships in chemical science, tenable in the United Kingdom by chemists from Italy) announces that H.R.H. the Prince of Wales has consented to accept the position of patron of the fund, which was inaugurated in 1916 to raise the sum of 100,000*l*., and that it is proposed to raise 50,000*l*. of the amount by a Million Shilling Fund, which will be devoted to (1) the provision of Ramsay research fellowships, tenable wherever the necessary equipment may be found; and (2) the establishment of a Ramsay memorial laboratory of engineering chemistry in connection with University College, London.

Donations should be sent to Lord Glenconner, the honorary treasurer of the fund, at University College, Gower Street, W.C.1.

WE regret to record the death of the Rev. Edward Frank Sampson, student of Christ Church, Oxford, which took place at Clifton on October 1. Mr. Sampson was born at Bristol in 1848, and educated, under the late Dr. Caldecott, at the Bristol Grammar School, whence he proceeded in 1865 to St. John's College, Oxford, having been elected to a Bristol scholarship in mathematics. He had a very successful career as an undergraduate, taking first classes in Mathematical Moderations and the two Final Schools of Mathematics and Natural Science; and in 1869 he was elected to a clerical senior studentship at Christ Church, being appointed lecturer in mathematics in 1870 and a tutor of the house in 1874. He was a good and sound, though not a brilliant, mathematician, and a painstaking, conscientious, and efficient teacher, many of his pupils owing him deep gratitude for the unstinted help, pecuniary and other, that he gave them. But his chief interest did not lie in mathematics and its developments. He was an administrator and reformer, with a very deep sense of the duty he owed to undergraduates both as tutor and cleric. He was a man of great energy and tenacity, and his position as one of the censors of the house, to which office he was appointed in 1877, greatly helped in the promotion of necessary reforms. Ill-health caused Mr. Sampson to resign the censorship in 1894, and in 1900 he retired from active college work.

THE University of Pennsylvania is devoting special attention to a scientific analysis of North American Indian dialects. The last contribution on this subject is an elaborate monograph by Dr. Franz Boas on the language of the Tlinqit Indians, published in vol. viii., No. 1, of the University Anthropological Publications. The material has been collected by Mr. Louis Shotridge, a full-blood Chilkat Indian, and it has been arranged by Dr. Boas, the leading expert in this branch of philology. The difficulty of reproducing in type the complicated system of transliteration necessary to represent the sound-forms has been skilfully surmounted.

A VERY able account of the habits of the sparrow-hawk during the nesting period, by Mr. J. H. Owen, appears in *British Birds* for September. Among other things, Mr. Owen comments upon the very long time an egg takes to hatch after the embryo has chipped the shell. Out of eleven eggs kept under observation, six took two days to hatch. In another case the hen was seen to assist the chick to emerge by breaking away the shell. Though the author believes that the cock determines the site of the nest, he seems never to take any part in incubation, but during this time he hunts for the hen, bringing her food to the vicinity of the nest. Though more than three hundred victims have been more or less certainly identified at such nests, only two were game-birds; one of these was a nestling red-legged partridge, the other a pheasant, also in down. Although farmyard chicks were abundant in the neighbourhood of the nests under observation, none were ever taken by these birds, and this is a point worth noting. Finally, Mr. Owen remarks striking differences in the behaviour of sparrow-hawks when disturbed at the nest, some stealing off silently, others leaving with much screaming, the male also taking part in such protests.

IN the current issue of the *Quarterly Journal of Microscopical Science* (vol. lxiii., part 2) Mr. J. Bronté Gatenby gives a very useful summary of our knowledge of the remarkable phenomenon of polyembryony as met with in the parasitic Hymenoptera. Many of these insects, as is well known, deposit their eggs within the eggs of other insects, the young parasite following out its own development in the body of the larval host. This development is often of a very singular character, for from a single egg a large number of individuals may be formed by a process of embryonic budding. Not less interesting is the manner in which enveloping membranes are formed around the developing mass. In the first place, a nutrient envelope, the tropho-amnion, is derived from the polar bodies of the parasitic egg, the nuclei of which divide for the purpose, while an outer covering, of an epithelial character, is formed from certain cells of the host. The larval parasites feed upon the internal organs of the larval host, apparently taking care not to injure it vitally until they no longer require it, when they pupate, either inside or outside the dead larva.

IN the Proceedings of the Geologists' Association (vol. xxix., p. 46, 1918), Mr. Arthur L. Leach brings forward very interesting evidence of the occupation of the submerged forest-lands off the coast of Pembrokeshire by flint-chipping man before the full growth of the forest-trees. This occupation may date from early Neolithic times, and a minimum coastal subsidence of 30 ft. has since occurred.

MR. EDWIN KIRK (*Amer. Journ. Sci.*, vol. xlvi., p. 511, 1918) records successive epochs of glaciation in Alaska in past geological times, including what is believed to be the first record of Silurian "tillite." The conglomerates on the Alaskan border, previously described by Cairnes (1914) as probably of Permo-Carboniferous age, are shown to be paralleled by others that lie between high Carboniferous and Triassic horizons.

AN important contribution to our knowledge of the Cretaceous strata of the southern hemisphere is made by Sr. Anselmo Windhausen in the *Boletin de la Academia Nacional de Ciencias en Cordoba (Argentina)* (vol. xxiii., p. 97, 1918). Under the name "Neocomiano" the whole Lower Cretaceous sequence in the Argentine Cordillera is reviewed, and the free interchange of marine forms between this region and the Himalayas is pointed out in its geographical significance.

DURING the summer Dr. Arnold Romberg has made some interesting seismometric experiments at the Hawaiian Volcano Observatory (Weekly Bulletin, vol. vi., 1918, pp. 87-92). A new upright pendulum has been built for determining the direction from which local earth-waves proceed. A short-period, highly damped horizontal pendulum with heavy mass has been arranged, recording optically on bromide paper running at high speed. By closing up the lines on the drum, this can be done without much additional expense. This instrument has already given a clear, open record of a local earthquake. Another change promises to reduce the friction of the pointer in the smoked-paper mode of registration. A new stylus has been made, consisting of a lever of an extremely light and fine glass tube with a minute sharp-edged watchwork wheel rotating at the end in a glass bearing, the wheel itself being the writing-pen.

THE report on the mineral resources of the Philippine Islands for the year 1916 has just been issued by the Division of Mines of the Government of the Philippine Islands. The only product of any importance is gold, the output of which is valued at 307,450*l.*, the highest figure yet reached. It is interesting to note that a small quantity of manganese ore, namely, 3000 tons, has been produced and shipped to Japan. It is also noteworthy that a small cement plant, with a capacity of 500 barrels per day, has been installed, and has been at work at Rizal since 1915; the cement made is said to be of highly satisfactory quality. A good deal of prospecting and exploratory work is being done, and the coal outlook in particular is well spoken of. It is stated that the Batan coalfield is to be reopened, and that it is possible that this will become the main centre of production; the Cebu and Danao fields are also attracting attention.

We have received a copy of the first number of the *Decimal Educator*, a quarterly publication of the Decimal Association. The principal objects of this new periodical will be to secure the adoption of a decimal system of coinage and the compulsory introduction of the metric system of weights and measures, and also to advocate improved decimal methods in education and business. The first article is an historical sketch of the Decimal Association, in which attention is directed to the important part played by the association in securing the appointment of the Select Committee of 1895, charged with inquiring into the question of metric weights and measures, and to the vigorous campaign waged by the association in the early years of the present century, which resulted in the Metric Bill of 1906. The Act of 1897, which legalised the use of metric weights and measures in trade, was also to a large extent due to the exertions of the association. Another article, on teaching the metric system, protests against the unreasonable stress which many text-book writers lay upon tedious and unpractical conversions from one system of weights and measures to another, and calls for a revision of the present methods of teaching the metric system. On the whole, this new publication promises to be a useful auxiliary to the metric and decimal cause.

Vol. ix. of *Technology*, the journal of the Manchester Municipal College of Technology, is a quarto volume of nearly 260 pages, and consists mainly of reprints of nineteen scientific and technical papers by members of the staff which appeared in journals and proceedings during the year 1915. The papers cover a wide field, from education and the labour problem to the construction of sewers and the abolition of smoke. They all bear more or less on the industries of the district, and show what an important asset the country possesses in an institution of this kind. As a typical paper, that of Mr. S. Evans may be mentioned. It deals with a score of cases in which some metal portion of a manufacturing plant had failed owing to causes not at once apparent. In each case the steps taken to investigate the cause of the trouble are described and the remedy found. The saving in money and time effected by investigations of this kind is enormous; it could safely be put down as several hundred times the salaries of the whole of the staff of the college. The greater the number of colleges in the country capable of turning out so creditable a year's work as this volume represents, the better.

Southport stands in the forefront for borough meteorological observations under the superintendence of Mr. Joseph Baxendell. The report of the Fernley Observatory for 1917, just issued, gives detailed observations which are very suggestive to other borough councils which are aiming to be of service in the varied interests of meteorology. Many of the matters discussed are obtainable only by steadily observing the different elements for a number of years. A useful and valuable table is given showing for practically all the health resorts in the British Isles the "comparative statistics for the year 1917." Some of the special features of interest at Southport in 1917 are the unprecedented low mean and extreme barometric pressures in August, the unusually dry period for nine weeks from June 7 to August 7, and the warm summer following a cold winter, which is mentioned as exemplifying the statement made by old writers. December had the highest mean barometric pressure of any corresponding month since the year 1879. In addition to tables of all ordinary elements, tables are given showing the amount and frequency of rainfall with different wind directions, and there are now added hourly averages of rainfall and sunshine for a term of years. Observations are supplied to the Meteorological Office and to the British Rainfall Organisation. Both the old and the new units of measurement are used in the tables, and if any criticism can be made it is that in such cases as the air temperature the use of both Fahrenheit and Absolute temperatures leads somewhat to confusion. The remarkable "discontinuity" in the seasonal rainfall records shown in the preceding report for 1916 has been interrupted in 1917 by the exceptionally heavy rains of August, with an excess of 2·55 in., and October, with an excess of 2·97 in., but the decreased rainfall in July and September is well maintained.

Seven years' experience in the Austrian Government Telegraph Department has led a writer in *Chemiker Zeitung* for August 3 to recommend zinc fluorides as a preservative of wooden poles. It compares favourably with copper sulphate. When complete impregnation of the wood is unnecessary, a partial application of sodium fluoride will be found to exhibit great preservative action.

L'Industria for July 15 describes a new method for the electrolytic extraction of copper from pyritic ashes. The method is based on the electrolytic conversion of sulphide or sulphate of copper into cupric or cuprous chloride by the action of chlorine at the anode. If in an electrolytic bath containing hydrochloric acid in solution the anode is surrounded by a mass of pyritic scoria, the chlorine liberated by the hydrogen attacks the oxides, sulphates, or sulphides of copper more rapidly than the oxides of iron, and combines with them to form cupric chloride. This reaction extends to the entire mass of scoria, so that the latter acts as an electrode. The copper loss by this method is only 0·1 per cent. A simple type of apparatus for applying the process industrially is described.

The permeameter devised by Mr. F. P. Fahy, of the Pennsylvania Railway Co., and described in the *Electrical World* a year ago, has been subjected to severe tests at the U.S. Bureau of Standards, and the report on it appears in the Bulletin of the Bureau for June. The instrument consists of an **H**-shaped iron core, on the cross-bar of which the main magnetising coil is wound. The magnetomotive forces between the top or bottom ends of the two upright limbs can be measured by two uniformly wound solenoids with their ends close up to the ends of the limbs. If one pair of core-ends is joined by a bar of magnetisable material, the magnetomotive force between the two ends is reduced. By means of compensating coils wound round the vertical limbs of the yoke near their ends, it may be brought up to its normal value. The magnetising force and the magnetic induction are then determined from the electromotive forces induced in the top and bottom solenoids on reversal of the magnetising current. For accuracy and consistency the Bureau regards the instrument as a distinct advance on previous permeameters.

MESSRS. ILFORD, LTD., referring to the article by Mr. Chapman Jones, in NATURE of October 3, on colour sensitised plates, write to say that the filter used for the photographs mentioned in the article was not a yellow filter, but their pale green filter No. 240, specially introduced for use with their special rapid panchromatic plate. Mr. Chapman Jones did not for a moment wish to suggest that Messrs. Ilford were not familiar with the proper use of certain light-filters, and regrets that his article should have given that impression. It is very satisfactory to have their assurance that the lack of perfection in the one example examined is due to the printing and reproduction processes rather than to the photography, owing chiefly to the difficulties in obtaining suitable inks. A reference to Mr. Chapman Jones's article will show that he did not credit anyone with having produced a plate of even sensitiveness throughout the visible normal solar spectrum, or, indeed, the spectrum of any other of the usual light sources. Those who use Ilford X-ray plates will find a pamphlet just issued by the company of considerable service, especially if they have difficulty in getting contrast, or are uncertain as to the best method of treating them. The "Notes" also contain advice as to printing from the plates, and the application of films for dental purposes which are put up in a special manner ready for use. Half a dozen excellent reproductions are included.

THE latest catalogue of Messrs. J. Wheldon and Co., 38 Great Queen Street, W.C.2 (New Series, No. 85), deals with ornithology, and should be of interest and service to many readers of NATURE. It contains many first and rare editions, and is conveniently arranged under the headings of British Islands, Cage Birds, Game Birds, etc., Pigeons and Poultry, Europe, Asia, Africa, North America, South America, Australasia, General Systems, etc., Miscellanea, and Morphology. We notice that Messrs. Wheldon have for disposal many sets and long runs of scientific serials, *e.g.* the *Ibis*, "British Birds," "Novitates Zoologicæ," "Proceedings of the Zoological Society of London," the *Zoologist*, etc. The catalogue is sent post free on receipt of 2*d*.

OUR ASTRONOMICAL COLUMN.

ELECTRIC-FURNACE SPECTRA.—An important study of the spectra of calcium, strontium, barium, and magnesium, as produced in the electric furnace at temperatures of 1650°, 2000°, and 2350° C., has been made by Dr. A. S. King at the Mount Wilson laboratory (*Astrophys. Journ.*, vol. xlviii., p. 13). The extension of the observations into the ultra-violet has shown that there is a limit beyond which no lines are emitted at a given temperature, and that the limit advances towards shorter wave-lengths with increase of temperature, as in the case of the continuous spectrum of an incandescent solid. The observations bring out very clearly the characteristics of the various lines, and permit their classification in relation to temperature. The line at λ 6573 is unique among the calcium lines, being faint in the arc and much weaker at high than at low temperatures in the furnace; it is much strengthened in the spectra of sun-spots, and may be used with confidence as a low-temperature indicator. In agreement with previous work, the magnesium line λ 4571 was also found to be a low-temperature line of extreme type. In the case of barium, there is not merely a sharpening of the lines as compared with the arc, but in several cases there is also a resolution of diffuse arc lines into two or three components; the resolved lines possibly occur among the faint absorption lines of the solar spectrum, suggesting that the solar conditions in the region where these lines are produced involve a moderately high temperature combined with low pressure.

THE NEBULAR HYPOTHESIS.—The present position of the nebular hypothesis is discussed by Prof. J. H. Jeans in an interesting article which appears in the October issue of *Scientia*. The absence of adequate observational evidence of successive stages in the process conceived by Laplace being possibly due to instrumental limitations, the hypothesis can only be tested by mathematical research on the sequence of configurations of a rotating and condensing mass of gas. On the assumption that the mass is homogeneous and incompressible, it has been shown that systems corresponding closely with binary and multiple stars would be produced. When account is taken of the increase of density towards the centre, only approximate solutions of the problem are available. It appears, however, that for densities greater than one-quarter that of water the result would be very similar to that for an incompressible mass, while for lower densities the form assumed would be that of the lens-shaped figure deduced by Roche. In the latter case, after the attainment of a certain critical velocity, no further change of shape would be produced, but matter would be ejected from the periphery, and, as a result of tidal forces, the ejected matter would take the form of two spiral arms. It can be further shown that these filaments will only break up when they are on a sufficiently massive scale, and that when a reasonable value is assumed for the density of the primitive nebula, the condensation nuclei would be comparable in mass with the sun. It is thus suggested that, while the process imagined by Laplace is quite inapplicable to the solar system, its action is exhibited on a far grander scale in the giant masses of the spiral nebulæ; the products of disintegration are not planets and satellites, but streams of stars.

THE PROBLEM OF ADULT EDUCATION.

DURING the Session of 1917 the Minister of Reconstruction, the Rt. Hon. Christopher Addison, appointed a Committee, of which the Master of Balliol is the chairman, "to consider the provision for, and possibilities of, adult education (other than technical or vocational) in Great Britain, and to make recommendations."

The Committee has recently issued a most important interim report (Cd. 9107, price 3*d*.), which demands the earnest consideration of all who are interested in the industrial, social, intellectual, and moral well-being of the nation.

As a result of its inquiries and of the evidence offered the Committee has come to the conclusion that before the just claims of adult education can be considered and adequately met, it is indispensable to have regard to the industrial and social conditions under which the nation exists. There is unquestionably a wide and growing demand for education for adults of a non-vocational character, with a view to fuller personal development and with the object of promoting a healthier social intercourse and generally of equipping the workers, both men and women, for wider industrial, social, and political responsibilities, so that they may take their full and rightful share in the national life and well-being. It is fully recognised in the report that the development of the education of the child and of the adolescent, foreshadowed by Mr. Fisher's measure, now happily become law, is essential to further opportunities for the continued education of the adult, who will thereby be the better fitted to avail himself of the experiences of life, and to seek and find a wise solution of the problems to which they continue to give rise. The recent enfranchisement of large numbers of women lends additional impetus to the demand for means of more extended facilities of adult education, which is, after all, to be regarded as essential for men and women alike, however great may be the development in the education of children and adolescents.

An interesting review is given of the present facilities of adult education as exemplified in the University Extension system, that of the Adult Sunday School, the Workers' Educational Association, Ruskin College, the Working Men's Colleges, and other bodies, including the work of the local education authorities, but the conclusion is rapidly reached that so long as the present economic conditions prevail these and other means of educational progress must remain short of their full harvest, and the nation be left vastly poorer thereby. The evil conditions which beset the worker and hinder his full educational and social development are the subject of careful review. They are found in the abnormal length of the working-day in most industries, in the heavy and exhausting work in others, in the demands of excessive overtime, in the shift system and that of "split turns," in night-work, continuous or periodic, in the evil effects of continuous, monotonous labour, and, finally, in the insecurity of employment which besets many workers in industrial and rural occupations.

Proposals are made to shorten by law the working-day, so that it shall not exceed, with some qualifications, eight hours in any industry; that in heavy, exhausting kinds of work the legal working-day shall be shorter than the normal, and, where possible, mechanical devices introduced, such occupations to be specially regulated; that overtime and "shift-work" shall be the subject of legal regulation and reduced to a minimum; and that regular night-work shall be prohibited, whether periodic or continuous, except where it is absolutely necessary. With the view of meeting the evils of continuous, monotonous labour, alternating forms of employment are suggested, and the establishment of works committees for the consideration of matters affecting workshop life. Measures should also be taken to minimise the ruinous effects of unemployment by the reorganisation of industry or the extension of the principle of insurance. Other measures of reform are also suggested with respect to schemes of housing and town-planning, in order to secure better domestic conditions and pleasanter surroundings for the worker, and there should be established in every village an institute or hall under public control. An eloquent testimony is offered at the conclusion of the report to the splendid qualities and potentialities latent in our people, as shown by their sacrifices in the present disastrous war, which render them worthy of any effort to improve and make worthy their conditions of life.

The suggestions in the report are made by men and women experienced not only in education, but also in the actual conditions of industrial life, and may be commended to the earnest consideration of all who are responsible for the future well-being of the nation. They are the pre-conditions of any form of effective adult education.

A MONOGRAPH ON COW-WHEAT.

M. G. BEAUVERD'S "Monographie du genre Melampyrum," which has recently appeared (*Mémoires de la Société de Physique et d'Histoire naturelle de Genève*, vol. xxxviii., fascicule 6), is an intensive study of a genus carried out under the serious limitations imposed by the present war conditions. Melampyrum, the British cow-wheat, which is represented in our flora by four species, is one of a small group of genera of the family Scrophulariaceæ, which are characterised by a hemiparasitic habit. They are small herbaceous plants which draw part of their nourishment from other plants, to the roots of which they become attached by suckers developed upon their own roots. Many of them have the peculiarity of turning black on drying.

The genus, fourteen species of which are recognised by M. Beauverd, is widely distributed in the northern hemisphere. There are four areas of distribution: a North American, extending right across the continent; an Eurasiatic, comprising the greater part of Europe with Central Asia; an eastern Mediterranean area; and a Far East or Chinese and Japanese area. M. Beauverd's work, so far as the systematic study of the species is concerned, is very largely based on the material in the various public and private Swiss collections, which, though rich in a representation of Central European forms, would naturally contain a less extensive series from other areas. His knowledge of British forms is derived almost exclusively from Mr. G. C. Druce's collection, which he has had the opportunity of studying. The author has not consulted the great British and Russian herbaria, apart from which the study of the central and eastern Asiatic forms must be far from complete. Further, in the systematic study of a genus it is of importance to examine the original specimens on which previously described species and varieties are based, and a large proportion of these are to be found only outside the circumscribed area of M. Beauverd's studies. The limitations under which the work has been carried out must, therefore, necessarily lead to a want of balance between the treatment of the Central European forms and of those occurring outside that area and to a lack of completeness in the systematic scheme.

Within the limits imposed M. Beauverd has made good use of the material available. He has studied in the field the range of variation of species and forms, and by a careful microscopic study of the details of the flower, the technique of which he describes at some length, he has convinced himself of the relative value of fixed qualitative and variable quantitative characters in the discrimination of species and of inferior grades of relationship. Thus M. Beauverd regards the two different methods of dehiscence of the fruit, to which he had previously directed attention, as affording criteria for the two main divisions of the genus. The author has also noted in some species the presence of a ring of hairs on the inside of the corolla-tube above the base, in such a position as to protect the nectar beneath it from being pillaged by an insect biting through the lower part of the tube; the presence or absence of this "nectarostegium," the minute structure of the hairs associated with the anthers or occurring elsewhere in the flower, and the form of the bracts at the top of the inflorescence, afford constant characters for the differentiation of sections or aid in the diagnosis of the species.

On the other hand, variable quantitative characters such as the number of joints in hairs of the same plan of structure, the relative size of flowers or leaves, the number of sterile bracts or of stem-nodes between the root and the inflorescence, the size and frequency of the marginal teeth of the bracts, the size of the calyx-teeth, and the degree of opening of the mouth of the corolla, are of value in assigning limits to subspecies and varieties. The author's discussion of these points and their application in the systematic scheme adopted by him afford the most interesting chapter in the memoir.

Apart from its value as a contribution to the systematic study of the genus, the monograph supplies a useful *résumé* of previous work. The first chapter, occupying fifty pages, is a chronological précis of this nature. The morphology of the vegetative or reproductive organs is treated in detail in another chapter, while a chapter entitled "Biological Notes" deals with pollination, the distribution of the seeds by the aid of ants, and some ecological notes based on the author's own observations.

LACUSTRINE FAUNA IN THE FAR EAST.[1]

THE two memoirs before us contain the first five of a series of reports upon material collected, for purposes of comparison with a corresponding ecology in the Indian fauna, by Dr. Annandale in certain lakes of the Far East, namely, in Lake Biwa in Japan, in Tai Hu Lake in the Yangtse Delta, and in Talé Sap, a lagoon on the eastern coast of the Malay Peninsula; with them is incorporated a short critical dissertation on Oriental Batrachia in general.

Lake Biwa, with an area of 269 square miles, lies among hills about forty miles distant from the sea; as it is more than 200 ft. deep in many parts and reaches a depth of 320 ft. in some places, and as there is considerable difference in summer temperature between the open surface and the depths, there is some variety in its biological conditions. Tai Hu, about sixty miles in length and in breadth, is a muddy lake of uniform conditions, nowhere exceeding 12 ft. in depth; though it is forty miles from the sea and its water is quite fresh, its fauna contains a distinct marine or estuarine element. Talé Sap differs from the other two lakes in lying on the seaboard and having a narrow sea-inlet; like the Chilka Lake in Orissa, it consists of two distinct basins of unequal density—though the inner basin is fresh, or practically so, throughout the year—and so presents variable conditions; the greatest depth of the main fresh-water portion is about 16 ft.

The collections described in the present instalments are the Polyzoa in part (Entoprocta and Ctenosomatous Ectoprocta), the Mollusca of Lake Biwa, and the Hydrozoa and Ctenophora, all by Dr. Annandale himself, the aquatic Oligochæta by Col. J. Stephenson, I.M.S., and the aquatic Hemiptera by Mr. C. A. Paiva. Most of the reports are distinguished by attention to anatomical details and to biological interpretations of fact.

The Polyzoa comprise five species from Talé Sap and two from Tai Hu. Two of them (*Triticella pedicellata* and *Paludicella elongata*) have not before been recorded from tropical latitudes. A third noteworthy form, closely akin to Loxosomatides, but differing in the arrangement of the muscles of the stalk, is distinguished as a new genus, Chitaspis.

The Mollusca of Lake Biwa include twenty-nine species, of which eleven are restricted to this lake and eleven others are peculiar to Japan. Most of the genera (*e.g.* Limnæa, Planorbis, Vivipara, Bithynia) are cosmopolitan, or (*e.g.* Anodonta, Valvata) palæarctic, or, like Melania and Corbicula, of common occurrence in tropical and subtropical latitudes. The author distinguishes a rupicolous community of species quite distinct from that inhabiting the mud and sand in shallow water, and a congeries of species restricted to the depths, among the latter being the only representatives of Pisidium and Valvata occurring in the lake.

Among the Hydrozoa identified are *Cordylophora lacustris,* from Tai Hu, and five species from the brackish parts of Talé Sap. A description of a new genus of Hydromedusæ, Asenathia, from the Gangetic Delta, is also included; this the author suspects to be the sexual generation of the curious hydroid Annulella recently described by Ritchie from that part of Bengal.

Among the aquatic Oligochæta, *Branchiura sowerbyi* and *Limnodrilus socialis* were found in association here as in India; a new species of Chætogaster commensal in sponges is described, and a new genus Kawamuria—a Branchiura without gills and having the penis-sac provided with a penis—from the depths of Lake Biwa. Col. Stephenson also describes a new species of Criodrilus, found at the remarkable depth of 180 ft. in this lake.

The aquatic Hemiptera are for the most part common Oriental forms; but *Microvelia sexualis,* from Talé Sap, is a new species of Hydrometrid representing a genus hitherto known only from North America.

[1] "Zoological Results of a Tour in the Far East." Edited by Dr. N. Annandale. Memoirs of the Asiatic Society of Bengal, vol. vi., pp. 1–74 and pp. 75–155.

CARBONISATION REACTIONS.[1]

IT is difficult to obtain clear information about the reactions in carbonisation by the direct distillation of coal in the laboratory, especially about minor, though important, products such as toluene, benzene, etc., of which the quantities available become excessively small. Therefore the author, in conjunction with Dr. S. F. Dufton, chose to investigate the stability of individual compounds in different atmospheres when passed over heated coke, with a time of contact of the same order as met with in carbonising practice. The behaviour of the compounds was dependent on conditions of temperature and concentration, apparently in accordance with the laws of chemical dynamics. Benzene, at varying partial pressures in an atmosphere of nitrogen, which was assumed to be inert, showed signs of incipient decomposition at 550° C., leading to the production of diphenyl. At higher temperatures this was more extensive, and *p*-diphenylbenzene also appeared. The former condensation at least is reversible. Benzene in an atmosphere of hydrogen yielded much less diphenyl under otherwise similar conditions, and at 800° C. is scarcely decomposed at a concentration of 5 per cent. by volume, while diphenyl in an atmosphere of hydrogen is reduced to benzene. This doubtless accounts for the practical non-occurrence of diphenyl in coal-tar, although this substance is readily formed from benzene in the absence of hydrogen. Benzene did not yield naphthalene or unsaturated compounds. At 900° C., even in hydrogen, benzene was extensively broken down with the formation of carbon. Toluene in nitrogen shows signs of decomposition at 550° C., but there are now two possibilities—reactions through the nucleus and also through the side chain. The product is more complex, a solid being formed, which was identified as stilbene $(CH.C_6H_5)_2$, and also an oil. At 750° C. decomposition was more extensive, naphthalene and anthracene being identified among a number of other products. On substituting hydrogen for nitrogen the decomposition was much accelerated, but with the production of benzene and methane and smaller quantities of solids. The formation of stilbene, which occurs with the liberation of hydrogen, is inhibited. Methane and benzene react in the reverse direction to form toluene, but only very slowly. Thus hydrogen protects benzene from decomposition, whereas it decomposes toluene, but in the sense of breaking off the side chain while hindering molecular condensations with elimination of hydrogen, which are a characteristic effect of heat on the lower aromatic hydrocarbons. The xylenes resemble toluene in behaviour, while cresol is reduced by hydrogen at 750° C. to toluene, and necessarily to benzene also. The importance of atmosphere

[1] Abstract of the William Young Memorial Lecture of the North British Association of Gas Managers, Glasgow, September 6, 1918, by Prof. John W. Cobb.

in carbonisation is therefore great, and can influence the course of the process. This is seen in practice in the results of steaming charges in vertical retorts. The hydrogen of the water-gas formed doubtless operates in the sense shown above, as well as physically in sweeping out the vapours before decomposition can have gone too far. The lightness of the hydrogen molecules and consequent high diffusivity doubtless promote this physical effect, but the predominant influence is chemical. Whether it is better to introduce the water-gas from the outside or to generate it *in situ* by steaming remains to be shown. In any case, there is an advantage to be gained by the admixture of water-gas in that the proportion of the heat of the coal in the gas is increased. When steam is introduced into the retort, reactions which lead to the formation of ammonia, as in the Mond gas producer, are called into operation. It is steam which promotes the formation of ammonia, and not hydrogen, on which undue stress has been laid since the time of Tervet. Experiments made in conjunction with C. A. King show that steam alone among a number of gases tried had any marked effect in the production of ammonia from coke at 800° C. Characteristic of the results of steaming charges in recent experience is the much increased yield of ammonia, and also of tar, which contains less of the heavy complex condensation products than ordinary horizontal-retort tars. This is important in connection with the carbonisation of coal as a possible source of fuel-oil. In considering the effect of heat on hydrocarbons, there is evident a tendency for molecules to coalesce with the production of more and more complex six-atom carbon-ring compounds, with the elimination of hydrogen, which operates in the reverse sense. The stability of the six-atom ring structure seems characteristic of carbon even under the most drastic treatment, and it is interesting to note that the investigations of the Braggs show that the same orientation can still be detected in the diamond and graphite.

FORTHCOMING BOOKS OF SCIENCE.

Agriculture and Horticulture.

Duckworth and Co.—A new edition of Agricultural Botany, Prof. Percival. *J. B. Lippincott Co.*—Productive Pruning, Prof. A. Dickens, illustrated; Productive Small Fruits, Prof. F. C. Sears, illustrated; The Potato, W. Stuart, illustrated; Experimental and Agricultural Botany, Prof. M. T. Cook, illustrated; Laboratory Manual of Farm Crops, O. W. Dynes; Productive Sheep Husbandry, W. C. Coffey, illustrated. *J. Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Botany for Agricultural Students, Prof. J. N. Martin.

Anthropology and Archæology.

Macmillan and Co., Ltd.—Folk-lore in the Old Testament: Studies in Comparative Religion, Legend, and Law, Sir J. G. Frazer, 3 vols. (part i., The Early Ages of the World; part ii., The Patriarchal Age; part iii., The Times of the Judges and Kings; part iv., The Law).

Biology.

Cambridge University Press.—Evolution and the Doctrine of the Trinity, S. A. McDowall. *Constable and Co., Ltd.*—Animal Life and Human Progress, edited with an introduction by Prof. A. Dendy (containing Man's Account with the Lower Animals, Prof. A. Dendy; Some Educational and Moral Aspects of Zoology, Prof. G. C. Bourne; Museums and Research, C. Tate Regan; Man and the Web of Life, Prof. J. A. Thomson; The Origin of Man, Prof. F. Wood-Jones; Some Inhabitants of Man and their Migrations, Dr. R. T. Leiper; The Future of the Science of Breeding, Prof. R. T. Punnett; Our Food from the Sea, Prof. W. A. Herdman; Tse-Tse Flies and Colonisation, Prof. R. Newstead); Coniferous Trees, A. D. Webster, illustrated. *J. B. Lippincott Co.*—The Chromosome Theory of Heredity, Prof. T. H. Morgan; In-breeding and Out-breeding, E. M. East and D. F. Jones; Localisation of Morphogenic Substances in the Egg, Prof. E. G. Conklin; Tissue Culture, R. G. Harrison; Permeability and Electrical Conductivity of Living Tissue, Prof. W. J. V. Osterhout; The Equilibrium between Acids and Bases in Organism and Environment, L. J. Henderson; Chemical Basis of Growth, Prof. T. B. Robertson; Primitive Nervous System, Prof. G. H. Parker; Co-ordination in Locomotion, A. R. Moore. *Macmillan and Co., Ltd.*—The Botany of the Living Plant, Prof. F. O. Bower, illustrated; A Text-book of Embryology, illustrated, vol. ii., Vertebrata (Amphioxus-Chick), Prof. J. Graham-Kerr. *J. Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Fresh-water Biology, Profs. H. B. Ward and G. C. Whipple, illustrated.

Chemistry.

Edward Arnold.—Petrol and Petroleum Spirits, Capt. W. E. Guttentag, with a preface by Sir John Cadman. *Baillière, Tindall, and Cox.*—Industrial Chemistry, edited by Dr. Samuel Rideal (Coal-tar Dyes, E. de Barry Barnett; Animal Proteids, H. G. Bennett; The Carbohydrates, Dr. S. Rideal; Fats, Waxes, and Essential Oils, W. H. Simmons; The Industrial Gases, Dr. H. C. Greenwood; Silica and the Silicates, J. A. Audley; The Rare Earths and Metals, E. K. Rideal; The Iron Industry, A. E. Pratt; The Steel Industry, A. E. Pratt; Gas-works Products, H. H. Gray; Organic Medicinal Chemicals, M. Barrowcliff and F. H. Carr; The Petroleum Industry, D. A. Sutherland; Wood and Cellulose, R. W. Sindall and W. Bacon; Rubber, Resins, Paints, and Varnishes, Dr. S. Rideal). *Cambridge University Press.*—Recent Discoveries in Inorganic Chemistry, J. Hart-Smith. *J. and A. Churchill.*—Catalytic Hydrogenation and Reduction, Dr. E. B. Maxted, illustrated; and a new edition of A Handbook of Colloid Chemistry, Dr. W. Ostwald, translated by Prof. M. H. Fischer, illustrated. *Constable and Co., Ltd.*—The Life and Letters of Joseph Black, M.D., Sir W. Ramsay, with an introduction dealing with the life and work of Sir William Ramsay, Prof. F. G. Donnan, illustrated; The Profession of Chemistry, R. B. Pilcher; The Production and Treatment of Vegetable Oils, T. W. Chalmers, illustrated; Trinitrotoluenes, G. Carlton Smith. *Longmans and Co.*—Monographs on Industrial Chemistry, edited by Sir Edward Thorpe (Synthetic Colouring Matters: Vat Colours, Prof. J. F. Thorpe; Naphthalene, Prof. W. P. Wynne; Synthetic Colouring Matters: Azo-Dyes, Dr. F. W. Kay; Utilisation of Atmospheric Nitrogen: Synthetical Production of Ammonia and Nitric Acid, Prof. A. W. Crossley; Cement, B. Blount; The Principles and Practice of Gas-purification, E. V. Evans; Refractories, Dr. J. W. Mellor; Ozone and Hydrogen Peroxide: their Properties, Technical Production, and Applications, Dr. H. V. A. Briscoe; The Natural Organic Colouring Matters, Prof. A. G. Perkin and Dr. A. E. Everest; Industrial Applications of the Rarer Metals, W. G. Wagner and W. E. F. Powney; Liquid Fuel for Internal-Combustion Engines, Sir Boverton Redwood, Bart., and Prof. J. S. S. Brame; Cellulose-Silk, C. F. Cross; The Electric Arc in Chemical Industry, Dr. J. N. Pring; By-product Coking Practice, E. Bury; Organic Synthetic Reactions: their Application to Chemical Industry, Prof.

J. B. Cohen; Synthetic Colouring Matters: Anthracene and Allied Dyestuffs, F. W. Atack; Synthetic Colouring Matters: Acridine and Xanthene Dyestuffs, Dr. J. T. Hewitt; Synthetic Colouring Matters: Azine and Oxazine Dyestuffs, Dr. J. T. Hewitt; Synthetic Drugs: Local Anæsthetics, Drs. W. H. Hurtley and M. A. Whiteley); and a new edition of Recent Advances in Organic Chemistry, Dr. A. W. Stewart, with an introduction by Prof. J. Norman Collie. *University of London Press, Ltd.*—Everyman's Chemistry: The Chemist's Point of View, and his Recent Work, told for the Layman, E. Hendrick, illustrated. *University Tutorial Press, Ltd.*—Senior Practical Chemistry, H. W. Bausor. *J. Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—Food: Its Composition and Preparation, M. T. Dowd and J. D. Jameson.

ENGINEERING.

Benn Bros., Ltd.—The *Electrician* Series: Electrical Measuring Instruments: their Design, Construction, and Application, Dr. C. V. Drysdale and A. C. Jolley; The Handling of Materials: A Manual on the Design, Construction, and Application of Cranes, Conveyors, Hoists, and Elevators (being the second and enlarged edition of Electric Cranes and Hoists), H. H. Broughton, 4 vols.; The Induction Coil, Prof. E. Taylor Jones; Manual of the Telephone, W. Aitken, 2 vols.; and new editions of Electric Mains and Distributing Systems, J. R. Dick and F. Fernie; Electric Switch and Controlling Gear, Dr. C. C. Garrard. *J. and A. Churchill.*—The Mechanical Principles of the Aeroplane, Dr. Brodetsky, illustrated. *T. Werner Laurie, Ltd.*—Text-book of Military Aeronautics, H. Woodhouse, illustrated. *Crosby Lockwood and Son.*—The Aircraft Identification Book for 1918: A Concise Guide to the Recognition of Different Types and Makes of all Kinds of Aeroplanes and Airships, R. B. Matthews and G. T. Clarkson; and a new edition of the Naval Architect's, Shipbuilder's, and Marine Engineer's Pocket Book, C. Mackrow and L. Woollard. *Sir I. Pitman and Sons, Ltd.*—Papers on Alternating-current Machinery, Hawkins, Smith, and Neville; Aeronautical Engineering, A. Klemin; Alternating-current Electrical Engineering, A. T. Dover, vol. i., General Principles; The Mechanic's Handbook, W. E. Dommett; Electrical Mining Machinery, G. F. Walker; The Calculus for Engineering Students, J. Stoney; and new editions of The Telephone Handbook, J. Poole; Modern Illuminants, L. Gaster and J. S. Dow; Reinforced Concrete, W. N. Twelvetrees; Elementary Aeronautics, A. P. Thurston; Induction Coils, G. E. Bonney and A. H. Allen; Electrical Engineers' Pocket Book, K. Edgcumbe. *J. Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—Water Rights Determinations, from an Engineering Standpoint, Prof. J. M. Witham; American Highway Engineers' Handbook, edited by A. H. Blanchard and others; Johnson's Materials of Construction: A Treatise for Students and Engineers on the Mechanical Properties of Engineering Materials, and a modification and revision of the earlier treatise by the late D. J. B. Johnson, Prof. M. O. Withey and J. Aston, edited by F. E. Turneaure; Essentials of Alternating Currents, W. H. Timbie and Prof. H. H. Higbie.

GEOGRAPHY AND TRAVEL.

Macmillan and Co., Ltd.—Russia, Mongolia, China, A.D. 1224–1676, J. F. Baddeley, with maps and illustrations, 2 vols.; Highways and Byways in Northamptonshire and Rutland, H. A. Evans, with illustrations by F. L. Griggs (Highways and Byways Series).

MATHEMATICAL AND PHYSICAL SCIENCES.

Cambridge University Press.—Matrices and Determinoids, Dr. C. E. Cullis, vol. ii. (University of Calcutta Readership Lectures); Problems of Cosmogony and Stellar Dynamics, J. H. Jeans; An Introductory Treatise on Dynamical Astronomy, Prof. H. C. Plummer. *Longmans and Co.*—Text-book on Navigation and Nautical Astronomy, J. Gill, revised and enlarged by W. V. Merrifield. *Macmillan and Co., Ltd.*—Elementary Mensuration, Constructive Plane Geometry, and Numerical Trigonometry, P. Goyen; and a new edition of The Theory of Heat, T. Preston, revised by J. R. Cotter, illustrated. *Sir I. Pitman and Sons, Ltd.*—Trigonometry, H. Adams. *University Tutorial Press, Ltd.*—Intermediate Text-book of Magnetism and Electricity, R. W. Hutchinson. *J. Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—Graphical and Mechanical Computation, Prof. J. Lipka; Navigation (for students or mariners preparing to take examinations for officer's licences), Prof. G. L. Hosmer; A Treatise on the Sun's Radiation and Other Solar Phenomena, Prof. F. H. Bigelow, illustrated.

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MISCELLANEOUS.

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Philosophy and Psychology.

Cambridge University Press.—Moral Values and the Idea of God, Dr. W. R. Sorley (the Gifford Lectures, 1914–15); Psychological Principles, Dr. J. Ward (Cambridge Psychological Library). *Macmillan and Co., Ltd.*—The Philosophy of Rabindranath Tagore, S. Radhakrishnan; The Origin of Consciousness: An Attempt to Conceive the Mind as a Product of Evolution, Prof. C. A. Strong. *University of London Press, Ltd.*—Crime and the Criminal: Being the Jurisprudence of Crime, Medical, Biological, and Psychological, Dr. C. Mercier.

Technology.

Cassell and Co., Ltd.—Oxy-acetylene Welding, T. Newton and A. Eyles, illustrated; Watch Cleaning and Repairing, illustrated; Basket-making, D. Collier (*Work* Handbooks). *J. B. Lippincott Co.*—Decorative Textiles: An Illustrated Book on Wall, Floor, and Furniture Coverings, including Carpets and Rugs, Tapestries, Embroideries, Damasks, Velvets and Brocades, Laces, Chintzes, Cretonnes, Wallpapers, Drapery and Furniture Trimmings, Tooled and Illuminated Leathers, G. L. Hunter, illustrated. *J. Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Costume Design and Illustration, E. H. Traphagen, illustrated; Principles of Mechanism, W. H. James and M. C. Mackenzie, illustrated; Plain and Ornamental Forging, E. Schwarzkopf; Pattern-making, F. W. Turner and D. G. Town, illustrated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—Miss S. Margery Fry has resigned the seat on the University Council which she has occupied for nine years.

Mrs. Osler, on behalf of her family and friends, has endowed a scholarship of about 25*l.* per annum to be tenable by a woman student who, having taken the B.A. degree, undertakes to remain at the University for an additional year to prepare for the M.A. degree.

Miss E. H. B. Coghill has succeeded Dr. Mary Clarke as lecturer in hygiene in the Women's Training College.

Cambridge.—Mr. J. Gray, of King's College, has been appointed demonstrator of comparative anatomy for two years. The election of a Quick professor of biology is to take place on November 1. Prof. Nuttall, the present holder of the chair, is eligible for re-election.

London.—Mr. A. H. Barker will deliver two further public lectures on "The Principles of Fuel Economy in the Home" at University College, Gower Street, W.C.1, on Wednesdays, October 16 and 23, at 7 p.m. The lectures are designed to meet the needs of householders now faced with the problem of fuel economy. A syllabus of the lectures can be obtained from the Publications Secretary of the college by sending a stamped addressed envelope to him.

The sum of 20,000*l.* has been bequeathed by Mrs. C. H. Colburn to the Harvard University Medical School to establish a fund for research in tuberculosis.

The Barrow Steel Co. has offered 100*l.* per annum for the foundation of a scholarship at the Barrow Technical School, preferably for the benefit of children whose parents are in the employ of the donors.

Mr. A. Serena has given 20,000*l.* for the foundation of chairs of Italian in the Universities of Oxford and Cambridge. The Vice-Chancellors of the two Universities and the Minister of Education are to be consulted, and, with Mr. E. Hutton, the editor of the *Anglo-Italian Review*, requested to draw up the conditions on which the chairs should be established.

A meeting of the Textile Institute was held at Bradford on Friday last, when it was announced that nearly 7000*l.* had been received of the 50,000*l.* aimed at for the extension of the scope of the technology of the textile trades, to establish and maintain lectureships, to encourage invention and discovery, to promote the standardisation of tests, and to provide the necessary connection between the business and the scientific mind.

A meeting of business men was held at the Huddersfield Chamber of Commerce on September 24 to consider the scheme for the extension of the textile department of the Huddersfield Technical College. The scheme provides for the raising of at least 25,000*l.* for the purchase of a building and its equipment with up-to-date machinery. The following resolution was passed:—"That this meeting of employers engaged in the textile industry in the Huddersfield district approves of the scheme for the extension of the textile department of the Huddersfield Technical College, as outlined by the members of the sub-committee." We understand that the premises have now been acquired, and that the transfer of the existing technical department to the new building will begin immediately. Any sum not required for the equipping of the new premises will be used to found scholarships for textile students.

The memorial tablet and medallion of the late Mr. F. W. Rudler, which have been placed in the quadrangle of the University College of Wales, Aberystwyth (in which Mr. Rudler was one of the earliest professors, 1876–79), will be unveiled by Prof. J. Mortimer Angus in the presence of the court of governors and others on Friday, October 18. Mr. Rudler attached great value to students' geological excursions, in regard to which he himself rendered devoted service during his membership of the Geologists' Association. A few of his friends are, therefore, desirous of creating a fund to be capitalised, the annual income from which is to be devoted, on the recommendation of the professor of geology, towards the defrayment, where necessary, of the expenses of students during such excursions. Contributions to the suggested fund may be sent to the Registrar, University College, Aberystwyth.

For some time the Y.M.C.A. and other agencies have, with the approval of the military authorities, been carrying on valuable educational work among the troops on the lines of communication in France and at home. A new branch of the Directorate of Staff Duties has now been constituted at the War Office to direct and co-ordinate the educational training scheme of the Army, which was issued as a special Army Order on September 24. The deputy director of the new branch is Col. Lord Gorell, and the assistant director Sir W. H. Hadow, principal of Armstrong College, Newcastle. The new branch will be advised on matters of general policy by an Inter-Departmental Committee, which includes Mr. E. K.

Chambers (Board of Education), Sir John Struthers, K.C.B. (Scotch Education Department), and Major R. Mitchell (Ministry of Pensions). In addition, the following, among others, have been asked by the President of the Board of Education and the Secretary for Scotland to act as expert advisers on special questions as they arise:—Sir Graham Balfour, Director of Education, Staffordshire; Sir Robert Blair, Education Officer, L.C.C.; the Hon. W. Pember Reeves, director, London School of Economics; Dr. G. MacDonald, Assistant Secretary, Scotch Education Department; Dr. E. Salter Davies, Director of Education, Kent; Mr. Albert Mansbridge, vice-president, Workers' Educational Association; Prof. Gilbert Murray, Regius professor of Greek, Oxford University; and Prof. John Adams, principal, London Day Training College. We do not recognise a single representative of scientific or practical education in the list of the new branch and its advisory committee and individual experts, though we should have supposed that an educational scheme for the Army would necessarily be concerned largely with scientific and technical subjects. The special questions which will arise will certainly involve the consideration of scientific and technological training not entirely within the field of the educational administrators and expert advisers whose names are announced. The War Office should remedy what is a manifest deficiency in the constitution of its new branch.

SOCIETIES AND ACADEMIES.

CAPE TOWN.

Royal Society of South Africa, August 21.—Dr. J. D. F. Gilchrist, president, in the chair.—L. **Simons**: The velocities of two distinct groups of secondary corpuscular rays produced by a homogeneous Röntgen radiation, and their absorption coefficients in gases. The absorption coefficients in gases of the secondary corpuscular rays produced by the incidence of silver X-rays on a single gold leaf were found by calculation from the pressure at which the cathode ionisation falls to half its maximum value. They are probably too high for the fastest corpuscles produced. The log. cathode ionisation curves could be analysed into two distinct portions when the particles emerge from a very thin screen, giving two absorption coefficients in a gas, their ratio being 1 : 4·76. The maximum velocity of emergence of the slower corpuscle was found to be 65×10^8 cm./sec., and the velocity of the faster corpuscle was 96×10^8 cm./sec.—G. A. **Boulenger**: (1) A new lizard of the genus Latastia from Southern Rhodesia. (2) *Rana ornatissima* and *R. ruddi*.—Sir A. **Theiler**: A nematode of fowls having a termite as an intermediate host. Some time ago a farmer forwarded a species of termite infected with a nematode, inquiring whether these worms were a stage in the life-cycle of the wireworm of sheep (*Haemonchus contortus*). This possibility, of course, had to be excluded, but since they were larvæ it was concluded that they represented a stage in the life-cycle of a nematode, which had its habitat in a host that would consume termites. Many birds are known to eat termites; fowls are particularly fond of them. It was decided to feed infected termites as well as the larvæ extracted from them. For this purpose eggs were hatched in an incubator and the chickens reared under conditions excluding accidental infection. Infected termites were found on red soil in the neighbourhood of a Kaffir kraal. A series of experiments was carried out, and in every instance an imago was so obtained in the small intestines of the fowls. The control fowls were free of it, as well as controls running in an area not inhabited by the species of termite. The imago was identified as a Filaria, and since it turned out to be a new species the name *Filaria gallinarum* is proposed.—Sir Thomas **Muir**: Note on recurrents resolvable into a sequence of odd integers.—Miss E. M. **Doidge**: Meliolaster: a new genus of the Microthyriaceæ. A fungus occurring on *Piper capensis* is described, which combines certain characters of the genera Meliola and Asterina.

BOOKS RECEIVED.

The Applications of Electrolysis in Chemical Industry. By A. J. Hale. Pp. ix+148. (London: Longmans and Co.) 7*s.* 6*d.* net.

The Correlation between Relatives on the Supposition of Mendelian Inheritance. By R. A. Fisher. (Transactions of the Royal Society of Edinburgh. Vol. lii. Part ii. No. 15.) (Edinburgh: R. Grant and Son.)

British Antarctica (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. ii. No. 8. Brachiopoda. By J. W. Jackson. Pp. 177–202+plate. (London: British Museum (Natural History).) 5*s.*

Solutions of the Examples in a Treatise on Differential Equations. By Prof. A. R. Forsyth. Pp. 249. (London: Macmillan and Co., Ltd.) 10*s.* net.

DIARY OF SOCIETIES.

TUESDAY, OCTOBER 15.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—Some Notes on the Geology of the Persian Oilfields: H. G. Busk and H. T. Mayo.

WEDNESDAY, OCTOBER 16.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A New Illuminant for Microscopical Work: J. E. Barnard.

FRIDAY, OCTOBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

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

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NOTICE.

In consequence of the greatly increased cost of production it has been found necessary to raise the price of NATURE to 9d. The alteration will take effect beginning with the issue for October 24, from which date the Subscription rates will be as follow:—

For residents in the British Isles.

Yearly	**£2 2 0**
Half-yearly	**1 1 9**
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THURSDAY, OCTOBER 17, 1918.

THE SALVAGE OF NINETEENTH-CENTURY SCIENCE.

Theory of Functions of a Complex Variable. By Prof. A. R. Forsyth. Third edition. Pp. xxiv + 855. (Cambridge: At the University Press, 1918.) Price 30*s*. net. (First edition, 1893, pp. xxii + 682; second edition, 1900, pp. xxiv + 782.)

TO anyone interested in the progress of British science the appearance of a third edition of this spacious volume, well-nigh two hundred pages longer than the first edition, must be a very welcome event. All those who know the conspicuous services which the author has rendered to mathematical learning will wish to congratulate him. And those who have known the stimulus of personal contact with him, who can recognise, beneath the happy diction with which the book is everywhere written, the sympathetic teacher, always able and willing to realise the learner's point of view, but eager to inform with a wealth of detail that is truly wonderful, will remember and be grateful. For the book stands between a time when, largely by the exigencies of a certain examination, a proof was soundest if it involved a considerable piece of algebra, and a time when the youngest student can prove anything by a judicious arrangement of arrow-heads. And the multiplicity of its content, who shall describe? Nor is it possible to say that it is too long if it be remarked that the index contains, for example, neither the entry "aggregate" nor the entry "enumerable."

It is easy, of course, for a reviewer, taking sections of the subject over which he happens to have pondered more intently than wisely, maybe, to explain how much better the book could have been, or to exemplify—what mathematical students do not usually know—the number of amendments necessary to the finished form of a mathematical theorem. And some indications may be given of how the present reviewer would discharge this traditional ungrateful duty if he were compelled to it. But they may be brief, and limited to the earlier parts of the book. As regards nomenclature, there was an opportunity for rendering the use of the words *analytic* and *monogenic* more uniform. The French use (Cauchy, Picard, Goursat, etc.) differs from the best German use. Compare Weierstrass's statement in regard to a construct ("Werke," iv., p. 13; or iii., p. 101): "und bezeichne dasselbe als ein monogenes weil es in seinem ganzen Umfange durch irgend eins seiner Elemente vollständig bestimmt ist." As regards uniform convergence there is some change in the present edition, the remarks on p. 92 (*cf.* the theorem, p. 156) differing from the statement on pp. 83, 84 of the second edition, and still more from those on p. 127 of the first edition, where the phrase "für jedes dem Bereiche angehörige Werthsystem" is untranslated. The difference between the case of a series of real functions and that of a series of functions of a complex variable might usefully be remarked. In regard to the definition of a function of a complex variable there is no substantial change; there is no reference to the question whether the derivatives of the function need be assumed continuous; and a holomorphic function is both monogenic and continuous. And in regard to the fundamental question of the integration of a function of the complex variable there still remains what is surely a very substantial incompleteness. If it be held that the curve of integration need not be rectifiable, and the continuity of the function need not be uniform, it should surely be so stated. As examples of complaints that may be put forward for later pages, we select only three. The statement on p. 248, that the integral can be made to assume *any* value, is incorrect. The proof on p. 245, for any three periods of a doubly periodic function, does not seem to carry Corollary II. without further amplification. The footnote on p. 344 might now be supplemented by reference to Painlevé, "Acta Math.," xxvii. (1903), and Camb. Phil. Proc., xii. (1903), p. 235.

But all this class of criticism seems impertinent to such a corpus of learning. There are two other reflections which are suggested by its perusal. When one turns over its brilliant pages and inquires of the history, one has sorrowfully to confess that not any substantial or path-breaking development has been made by British thinkers. All this illuminating theory, so important for the history of human thought, we owe to Frenchmen or Germans, or others. The great names are Cauchy, Abel, Riemann, Weierstrass, and Poincaré. It is a very interesting question: Why is this so? In the second place, nearly all this matter is the work of the nineteenth century. When the present war shall finally cease, how long will it be before mankind will be able again to turn from the inevitable necessity for the production of commodities to putting together such another body of clarifying thought? Well indeed is it that such a summary as this volume constitutes has been made, and very grateful should we be to the author—for such work remains among the imperishable records of human endeavour, a real joy for ever—but will a similar, or even a more productive, salvage be possible in 2018?

A TEXT-BOOK OF PLANT PHYSIOLOGY.

Plant Physiology. By Prof. V. I. Palladin. Authorised English edition. Edited by Prof. B. E. Livingston. Pp. xxv + 320. (Philadelphia: P. Blakiston's Son and Co., 1918.) Price 3 dollars net.

IT has been a matter for surprise to those who were familiar, through the German edition, with Prof. Palladin's text-book of plant physiology that it had not hitherto been available in English. The German edition, which was based on the sixth Russian edition, appeared in 1911, so that we have had to wait unduly long for the present translation, which appears under the editorship of Prof. Livingston, of the Johns Hopkins University. The present work is based on the German edition, but it has been collated with the seventh Russian edition, which appeared in 1914, and any alterations have been included in the English text. Hitherto there has been available to students no text-book of plant physiology of small compass which could serve as an introduction to the larger works of Pfeffer and Jost. This book admirably fills the gap.

On p. 2 of the Introduction we find a list of the heats of combustion of hydrogen, carbon, starch, glucose, etc., and on p. 3 a discussion of the catalytic action of enzymes. It is thus clear from the outset that the author views the plant from the physico-chemical point of view, and keeps well to the front the dynamical aspects of the chemical processes occurring. Associated with this we find that—in the words of the editor—"Palladin's writing is more free from teleological misinterpretation of the relation between conditions and results than is that in most of the text-books hitherto available." The book may thus safely be put into the hands of students without the risk of the acquirement of a slovenly and unprogressive habit of thought.

The editor has provided footnotes—the authorship of which is clearly indicated—where the matter required bringing up to date or the author's treatment of a subject seemed to require elucidation or correction. These additions very greatly increase the value of the book, and many of them, as readers of Prof. Livingston's papers might expect, are models of what critical notes should be. These notes are most numerous in connection with photosynthesis, osmotic pressure, and water movement.

The book naturally brings to the front the work of Russian botanists, and renders available some results which the barrier of language has hitherto kept almost unknown. The treatment of fermentation and respiration, subjects to which valuable contributions have been made by Palladin and his pupils, is particularly good, but Kidd's work on the effect of carbon dioxide on both aerobic and anaerobic respiration should have been noted. The relation of oxygen to fermentation by yeast, which is imperfectly or erroneously treated in most text-books, is well brought out, though reference might have been made to the work of Horace Brown on the "occlusion" of oxygen by yeast-cells. Readers will be particularly glad to have an account of Palladin's work on the respiration of dead plants and of his chromogen theory of respiration. In dealing with transpiration both the part played by the stomata and the physical factors controlling the rate of diffusion of water-vapour from the plant might have been dealt with more fully. Mention might also have been made of the fact that both Gaidukov's observations on the reaction of Oscillaria to light of different colours, and those of Czapek on the relation of homogentisic acid to geotropic response, have been called in question. The treatment of growth, movement, and reproduction in part ii. is very much slighter than that of metabolism, and the subject of heredity is not dealt with at all.

All the citations of literature have been verified and the form of reference has been rendered uniform; special attention has also been paid to the transliteration of Russian names. Botanists will be interested to learn that, on his own authority, the author's name should be pronounced "Pallad′-din." V. H. B.

FUNDAMENTAL PRINCIPLES OF CHEMISTRY.

Stoichiometry. By Prof. S. Young. Second edition. Pp. xiv + 363. (London: Longmans, Green, and Co., 1918.) Price 12*s*. 6*d*. net.

AS was explained in the notice which appeared on the issue of the first edition (NATURE, vol. lxxviii., 1908, p. 98), this book, which forms one of the well-known series of text-books of physical chemistry edited by the late Sir William Ramsay, deals with the fundamental principles of chemistry.

The present notice is devoted primarily to a consideration of the new matter which has been introduced into the book in order to give some account of the results arising from the numerous investigations carried on during the last decade. Of these results, none, perhaps, have had a greater influence on our fundamental conceptions than those which have been arrived at as a consequence of the investigation of radio-active substances. We have become familiar with the idea of non-separable, or isotopic, elements, which may, or may not, have the same atomic weight. Prof. Young adopts the recommendations of Paneth as giving, perhaps, the best definition of the term "element"; according to this suggestion, isotopes are to be regarded, not as different elements, but as varieties of the same element, so that an "element" may be pure or mixed according to whether it contains only one kind of atom or different varieties of isotopic atoms. The recent determinations of the atomic weight of lead derived from different sources, which have a bearing on the same subject, are referred to, while in the chapter dealing with the periodic law, after explaining the modern conception of an atom, the author gives a short *résumé* of the conclusions drawn by Soddy, Russell, and Fajans regarding the positions taken up in the periodic table by the products of the disintegration of atoms. No reference is made in this chapter to the difficulty which has been experienced in including the rare earth elements in the table, while a still more surprising omission is the absence of any allusion to the exceedingly valuable work of Moseley on the X-ray spectra of the elements, which has provided us with a method for the determination of atomic numbers and has led to results of the highest importance.

The numerous investigations relating to osmotic pressure which have been carried on in England

and America are described and discussed, while the section dealing with adsorption has been extended so as to include an account of recent work in this field.

A description is also given of several new practical methods. Amongst these may be mentioned Morgan's method for determining the molecular weights of liquids from the weight of falling drops, and the methods suggested by Smith and Menzies for the determination of the boiling points and vapour pressures of substances.

From the examples which have been given, it will be evident that, with one or two exceptions, the book has been brought thoroughly up to date, and can be confidently recommended to anyone desirous of having a clear and comprehensive account of modern views relating to such subjects as the properties of atoms and molecules, and the general properties of gases, liquids, and solids.

J. K. W.

OPTICS IN EUCLID'S TIME.

L'Ottica di Euclide. By Prof. G. Ovio. ("Manuali Hoepli.") Pp. xx+415. (Milano: Ulrico Hoepli, 1918.) Price 7.50 lire.

It need scarcely be pointed out here that the greater portion of what we now call "optics," dealing as it does with applications of the laws of refraction, was unknown in the days of the Greek geometer. In this small volume Prof. Giuseppe Ovio, of Genoa, has condensed an exposition of the contents of two volumes known as "Optics" and "Catoptrics," of which the first is believed certainly to be due to Euclid, while his authorship of the second is regarded as rather more doubtful. In preparing this book Prof. Ovio has mainly based his work on the editions of Pena, Danti, and Heiberg, but has also consulted those of Gregory, Zamberto, and Freart.

"Optics Properly So-called," which forms the title of the first portion, is practically equivalent to our perspective geometry. It deals with the apparent dimensions of objects seen at different distances and in different directions. It thus consists of a collection of propositions really purely geometrical in character. For example, one proposition proves that an eye situated near a sphere sees less of it than one further off, but the visible portion appears larger. There are some theorems, on the other hand, of which the purport and meaning are rather vague, and Prof. Ovio's comments on these will be found useful. "Catoptrics" deals with reflection at curved surfaces. The propositions include proofs that a plane mirror produces an inverted image of the same size as the object, that rays after reflection at a concave surface sometimes converge and at other times diverge, and a large number of other properties, of which these may be regarded as typical representatives. According to Euclid, visual rays emanated from the eye and went to the objects.

Now that the younger generation no longer acquires its geometrical ideas from Euclid's elements, an interesting variation on our over-stereotyped school curricula might very well be introduced by occasionally teaching the subject-matter of this volume. Many of the proofs afford quite interesting lessons in deductive methods, and could very well be accompanied by excellent exercises in constructive geometry. But, unfortunately, the subject in its present form does not fall within the syllabus of school examinations.

G. H. B.

OUR BOOKSHELF.

Descriptive Catalogue of the British Scientific Products Exhibition, with Articles on Recent Developments. Pp. xxiv+268. (London, 199 Piccadilly: British Science Guild, 1918.) Price 2s. 6d. net.

The record of industrial achievement during the period of the war shown at the recent British Scientific Products Exhibition organised by the British Science Guild was much enhanced by the publication of a comprehensive descriptive catalogue. Whilst the contained details of the exhibits and their technical applications added interest to their examination and form a valuable record for reference, the inclusion of a series of articles on recent industrial developments should do much to drive home and explain what has been accomplished during the past four years by the successful co-operation of science and industry, and what is needed for that fuller and more permanent effort which is required to secure industrial progress and efficiency. The story has been told in many forms, but every repetition that can extend an appreciation of the problem is to be welcomed. The catalogue of exhibits contains concrete examples of recent developments which form the basis for the story, and their direct association with a series of twenty concise and well-written articles by authorities whose names are a guarantee of first-hand knowledge provides a helpful correlation between the results obtained in works and laboratories and the objects and methods which have secured their realisation.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, and Papers in Elementary Engineering for Naval Cadetships, November, 1917, and March, 1918. Pp. 40. *Elementary Engineering Papers for Naval Cadetships (Special Entry) for the Years 1913–1917.* Pp. 33. Both edited by R. M. Milne. (London: Macmillan and Co., Ltd., 1918.) Price of each 1s. 3d. net.

A volume of mathematical papers set to candidates for admission to the Military Academy and College was reviewed in a recent issue of Nature. The first of the present publications is a further set of such papers. The other book contains the papers in elementary engineering set at recent examinations for Naval Cadetships. The questions in this collection cover the ground of the elementary theory of steam- and gas-engines, link motions, lathes, etc., and also presuppose some knowledge of the theory of hydrostatics, heat, and graphical statics. They are well devised and very clearly put to the candidates. The wording is often such as to act persuasively on the examinees. That the questions are also up to date is indicated by the presence of some on aeroplanes and kites.

Answers are given by the editor in the case of questions of a mathematical or arithmetical nature. There is a misprint on p. 11 of the "Mathematical Papers," line 6 from the bottom. S. B.

A Short Hand-book of Oil Analysis. By Dr. A. H. Gill. Revised eighth edition. Pp. 209. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 10*s.* 6*d.* net.

THIS is a handy little book for a student of oil chemistry to commence his technical practice with. It is intended as an introduction to larger works such as that of Lewkowitsch, and deals with the chief animal and vegetable oils, petroleum products, and the various greases used as lubricants. It gives the essential information briefly but clearly, and includes a good number of references to original sources of information. The volume is written from the American point of view, and some of the apparatus mentioned is more familiar in American laboratories than in this country. Some of the books quoted, also, are not readily accessible here. The British reader, however, will have no difficulty with the greater part of the work, and he will find it a very useful guide. The first paragraph on p. 175 wants revision: it appears to have suffered in the press.

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 Perception of Sound.

THE recent publication of Sir Thomas Wrightson's valuable and extensive investigations on the functions of the various parts of the auditory mechanism has brought into prominence a fundamental divergence of opinion as to the place where analysis of the complex sound vibrations occurs and as to the mode of vibration of the basilar membrane. The view of Helmholtz may be said to be that most generally accepted at present. As is well known, this theory states that the basilar membrane responds by resonance in different parts to the component waves of the complex, and that each of these components gives rise to its own sensation on arriving at the brain. The analysis takes place in the cochlea. Sir Thomas Wrightson's theory, which has received the powerful support of Prof. Keith, states that the basilar membrane as a whole follows in its wave form that of the complex, that the form of this complete compound wave is transferred to the nerve-fibres, and that no analysis takes place until the brain is reached.

Careful consideration of the evidence brought forward in support of this view has aroused several difficulties in my mind which, I venture to think, require explanation.

In the first place, there are certain physiological facts which make it extremely difficult to accept any sort of transmission of a complex wave form through a nerve-fibre. The work of Keith Lucas and his colleagues has shown that the process set going in a nerve-fibre has a definite time-course and magnitude, whatever be the way in which it is produced. If a sound-wave be enabled to stimulate a nerve-fibre by some appropriate receptor organ, the nerve process will be the same, however different the form of the wave. If this be true, it implies the necessity for a peripheral analysis, if there be any analysis at all. A similar difficulty arises in connection with the perception of notes of high pitch. If Sir Thomas Wrightson's theory is correct, the number of impulses passing along the nerve must be the same as the number of vibrations in the note, or possibly two or four times the number. The frog's nerve is incapable of responding to a second stimulus if it arrives less than 2/1000ths of a second after a previous one. It would, therefore, record all rates above 500 per second as identical. Doubtless this "refractory period" is shorter in the warm-blooded animal, but it is scarcely likely to be short enough to enable responses to 40,000 per second to be transmitted in their exact form.

It will be noticed by the physiological reader that Müller's law, which appears to have been first put forward by Sir Charles Bell, is involved here. It has been found that the sensation evoked from any nerve of special sense is identical, whatever the kind of stimulus applied. The peculiar quality of touch, taste, light, and so on, is due to the way the fibres end in the brain. Further than this in the way of explanation is at present impossible. But are we to suppose that the auditory nerve is the only exception to this law? What we should naturally expect would be that activity in one particular fibre, or, perhaps, set of fibres, in this nerve would be associated with the perception of one single definite tone, and that the form of the stimulus would be a matter of indifference. The theory of Helmholtz presents no obstacles in this respect.

In the second place, there is a physical question about which there seems some confusion. Many physiologists would be grateful to Lord Rayleigh if he would put us right here. There is no dispute as to the impression by the stapes on the liquid of the scala vestibuli of a series of impulses, corresponding in wave form with those air vibrations received by the membrana tympani. But, with the exception of the fact that the pressure is intensified, I am unable to see how these vibrations, when they arrive in the liquid, differ from those which would be present in the liquid if it were conducting sound in the ordinary way. It appears to be forgotten sometimes that liquids could not conduct sound unless they were both elastic and compressible. But the latter quality is, of course, extremely small, so that the amplitude of the vibrations is very minute. The actual movement in space of the column of liquid as a whole, contemplated by the Wrightson theory, is quite different, and, so far as I can see, the inertia of the mass would make it impossible for the force available to effect such movements at the rate of several thousand per second.

There is another point involved here which I confess to an inability to understand. When the stapes pushes in the membrane of the fenestra ovalis, the movement of the liquid shows itself simultaneously by a protrusion of the fenestra rotunda. Now the basilar membrane forms part of a partition between the two columns of liquid in the scala vestibuli and the scala tympani. If these columns were not connected at the apex of the cochlea, it is clear that the pushing in of the stapes must cause a bulging of the membrane into the scala tympani. It may be due to some oversight on my part, but I cannot see how there is a difference of pressure on the two sides when the column of liquid is a continuous one. This is a fundamental question in the Wrightson theory. It may further be pointed out that if the vibrations in the liquid to which the basilar membrane responds are the same as those of sound, there is naturally no difficulty with regard to hearing through the bone when the stapes has become fixed.

In the third place, objections made to the possibility of the basilar membrane acting as a series of resonators seem to me to have forgotten some facts pointed out by Helmholtz himself. The rate of vibration of a string is related, not only to its length, but also to its tension, and there is no reason why the range of the basilar membrane should not be increased by being more tightly stretched at its narrower end. So far from it being necessary to have a series of separate strings, Helmholtz demands only that a membrane of the shape of that of the basilar membrane should be more tightly stretched transversely than longitudinally, and in an appendix to the "Tonempfindungen" he gives a complete mathematical analysis of the vibration of such a membrane. I regret that this is beyond my mathematical capacity, but we may surely accept it. Prof. McKendrick has shown experimentally that resonance is possible in membranes immersed in water, as would be expected from theory.

On the other side, Held has stated that a single fibre of the cochlear nerve may supply a comparatively long stretch of the basilar membrane—undoubtedly a difficulty in the Helmholtz view. But the statement requires confirmation, and it must be a matter of great difficulty to decide it.

The explanation of the way in which the movements of the basilar membrane are altered in direction so as to stimulate the hair-cells is given very clearly by Sir Thomas Wrightson, and I have no objections to make to it. On the other hand, it is not clear why there are so many Corti arches and nerve-fibres present. One would have thought that a few would suffice to transmit the vibration if it occurs throughout the membrane at the same time and in the same form, no analysis taking place.

Sir Thomas Wrightson does not refer in his book to the interesting experiments of Yoshii, who found localised lesions in the organ of Corti as a result of prolonged exposure to a musical note.

Prof. Keith describes in great detail the minute structure of the organ of Corti, and states that various structures conform more to what is demanded by the Wrightson theory than to that of Helmholtz. I would demur somewhat to his view that every structure must have its function, although with deference to Prof. Keith's wide knowledge of the question.

It must be admitted that there are objections to be brought to both theories; but, on the whole, it seems to me that there are no vital ones to that of Helmholtz, whereas there are some to that of Sir Thomas Wrightson unless a satisfactory answer is forthcoming to those pointed out above.

W. M. BAYLISS.
University College, London.

Rainbow Brightness.

IT would, I suppose, be very difficult to compute theoretically the brightness of any selected part of a rainbow in terms of the sun's actual brightness.

But it occurred to me that we might compute the relative brightnesses of two selected portions of the primary and the secondary bow, simultaneously presented and situated along a common radius. The luminosities would be due to the same sun, and to raindrops of practically the same size, so that any differences would arise from the fact that for the primary bow there is one internal reflection, but for the secondary there are two, and from the fact that the angular constants differ. This difference in the angles will affect both the polarisation and the intensities of the light reaching the eye, and will also increase the breadth of the secondary bow to about 1·61 of that of the primary, thus further reducing the brightness of the secondary.

But by restricting attention to portions of the red in each bow, situated along a common radius, I think we may leave out of account the influence of the increase in breadth.

Let P, S denote the brightnesses of the two portions selected (along a common radius) from the red of the primary and of the secondary bow. Then, using Fresnel's formulæ, with $\mu=4/3$, I get

$$P=\frac{k}{22\cdot40}, \quad S=\frac{k}{52\cdot20},$$

where k is an unknown factor. Thus $P/S=2\cdot33$ for the relative brightness of the red of the primary to that of the secondary, as viewed by the naked eye.

Now the light of both bows is very considerably polarised in the planes of reflection, which are radial and pass through the sun, the eye, and the element of arc observed. For the primary, 96·69 per cent. is polarised in, and only 3·31 per cent. polarised perpendicular to, the reflection plane. For the secondary, the corresponding quantities are 90·64 per cent. and 9·36 per cent.

Through a Nicol prism, placed first so as to transmit the "in" light, and next so as to transmit the "perpendicular" light, we get for the primary bow:

$$\frac{P\ (\text{in})}{P\ (\text{perp.})}=29\cdot20.$$

Similarly, for the secondary bow:

$$\frac{S\ (\text{in})}{S\ (\text{perp.})}=9\cdot69.$$

Thus for the two positions of the Nicol the primary bow is reduced about twenty-nine times, and the secondary nearly ten times.

I have often experimented on the primary bow, and the element of arc practically disappears for the second position of the Nicol. I hope to experiment similarly on an element of arc of the secondary bow, which, though losing a smaller fraction of its light, is originally fainter than the primary, and so may also be expected to disappear, though for the "perpendicular" azimuth of the Nicol the remnant left of the secondary bow is a trifle (1·21 times) brighter than that of the primary.

Finally, we can compare the brightnesses of the bows, first with the Nicol in, and next with the Nicol perpendicular to, the polarisation plane:

$$\frac{P\ (\text{in})}{S\ (\text{in})}=2\cdot49,$$

so that the relative brightness with the Nicol slightly exceeds 2·33, that to the naked eye, when the Nicol transmits its maximum of each.

Next, $$\frac{P\ (\text{perp.})}{S\ (\text{perp.})}=0\cdot83;$$

so that the primary bow, as already stated, is slightly fainter than the secondary, when each is reduced by the Nicol to its minimum value. It would be of interest to test these cases by observation.

For the red light I gave 2·33 as the ratio of P to S for the naked eye. But to me the primary bow, viewed generally, appears brighter than this in comparison with the secondary. It is very difficult to make any true comparison on account of the varied colours. If we may assume that the secondary bow, owing to its greater breadth, is additionally weakened by the factor 1·61, we obtain P/S=3·75 for a rough estimate of the relative brightness without restriction to any particular colour.

So far I have not met with any published estimates of the relative brightness of the bows or of the precise character of their polarisation, so that these figures may be of interest. CHAS. T. WHITMELL.

Invermay, Hyde Park, Leeds, October 4.

An "Arbor Day."

At the meeting of the conference of delegates from provincial scientific societies to the British Association, held on July 4, a resolution was passed establishing October 21 as an "Arbor Day," and all the delegates present pledged themselves each to plant a tree if possible on that day, and to endeavour to induce members of all their societies and others to do the same. The time is now approaching for this to be carried into effect, and this letter is intended as a reminder.

By the wholesale cutting down of trees in this country during the last few years the scenery of our few woodland areas is losing its beauty, and we are greatly entrenching upon our very small reserve of timber. Although it is only by State action that the reafforestation of our country can be adequately effected, it is hoped that by the carrying out of this resolution some little benefit may be derived, and that year by year our "Arbor Day" may remind us of the paramount necessity of augmenting our home supply of timber.

JOHN HOPKINSON.

Weetwood, Watford, October 14.

Students' Microscopes on Loan.

We are conducting science classes on the lines of communication in France, and it has been suggested to us that some of your readers might care to loan students' microscopes for use in this work. If any who possess such instruments care to help us in this way, I shall be glad to hear from them. It will be understood that the instruments will be carefully kept and returned intact when finished with.

RICHARD WILSON,
The Librarian, Red Triangle Library.
Wimborne House, Arlington Street, S.W.1.

THE FUTURE OF THE COAL TRADE.

THE Coal Conservation Committee of the Ministry of Reconstruction has recently issued its final report, which forms, it need scarcely be said, a document of first-rate importance. Its form is decidedly curious, inasmuch as the report in itself is confined to a bare statement of the action taken by the Committee in appointing sub-committees, and the general adoption of the reports of these sub-committees, which are printed as appendices to the report; these reports are by the Power Generation and Transmission Sub-Committee, the Geological Sub-Committee, the Mining Sub-Committee, and the Carbonisation Sub-Committee. Of these the final report of the Mining Sub-Committee is undoubtedly the most interesting, and the most valuable in so far as it contains a number of recommendations of great technical and economic importance. Indeed, the reference to this sub-committee, which instructs it "to consider and advise what improvements can be effected in the present methods of mining coal with a view to prevent loss of coal in working and to minimise cost of production," covers a subject of most vital importance to the entire nation. British industrial supremacy is built up essentially upon a cheap and abundant coal supply, and whenever that supply becomes either less than sufficient for British industrial requirements, or more expensive than that of competing nations, Britain will cease to be a first-class Power. The safety and welfare of the nation thus depend so absolutely upon the coal supply that the recommendations of the Committee charged with its consideration assume a character of wide national interest.

The two principal subjects discussed are the loss and waste of coal and the cost of production. The former is subdivided into waste at the pit-head and loss underground. Waste at the pit-head is essentially confined to the excessive amount of coal used for colliery consumption. Relatively complete returns, representing 97 per cent. of the coal output of the country, have been obtained, so that tolerably trustworthy data are available, though it may be readily granted that the collieries that have failed to make returns are those at which the consumption is unduly high. The average colliery consumption for the kingdom is given as 6·8 per cent. of the output, or 18,400,000 tons of coal; in one of the other reports an estimate is given of the power employed in the mines and quarries of the United Kingdom, which is stated as 4000 million h.p.-hours. Taking this figure as due to the collieries alone, it would appear that our collieries consume no fewer than 10·3 lb. of coal per h.p.-hour, so that there is obviously room for much improvement. The report makes no reference to another source of waste, namely, the "free coal" which is allowed to coal-miners in some districts. Everyone who has had experience of these districts knows that the collier uses his free coal most extravagantly, and that quite considerable economies might be effected in this item without causing the slightest hardship, or even inconvenience, to the men concerned. Loss of coal underground is considered as arising from various causes, each of which is duly investigated.

The Committee considers that there has been a substantial improvement in respect of the small coal cast back into the goaf within the last ten years, and estimates the loss due to this cause as 0·91 per cent. of the output in 1915. It is obviously difficult to obtain accurate figures on this point, the collieries that are the worst offenders being, of course, those which furnish no returns, so that it is safe to say that the figures published by the Committee are below the actual wastage.

The only recommendation made is that a greater demand for small coal should be created—for example, by extending the market for briquettes. The present moment, when pitch is unusually cheap and the demand for household coal acute, is peculiarly suited to the generalisation of this convenient form of fuel, which has never come into public favour in this country, although it is deservedly popular on the Continent. This is surely a case where the Ministry of Reconstruction might do some real good if it would resort to deeds instead of mere words. Having regard to the scarcity of coal with which we are threatened during the coming winter, there is every reason why the Government should establish or assist in establishing briquetting plants in all centres where small coal is being wasted to-day, and thus usefully supplement the national coal resources.

An interesting and much-debated question is that of the loss of coal left in barriers underground; the Committee holds that a considerable proportion of barrier-coal might be worked if a central authority, such as a Ministry of Mines and Minerals, which the Committee wisely suggests should be created, had statutory authority to compel any barriers to be worked which could be worked safely, but it also points out that a large proportion of this barrier-coal could not be worked out without incurring risks which the Committee evidently finds to be unwarrantable. Under the head of coal left for support, the Committee discusses the effect of the well-known decision of the House of Lords in the Howley Park *v.* L. & N.W. Railway case (1912), and shows that it has operated adversely to the public interest, and is, moreover, probably opposed to the real intentions of the Legislature. The remedy proposed is that the prescribed distance within which a railway company has to pay compensation for coal left unwrought should be made to vary with the depth of the coal-seam, the distance suggested being equal to one-half of the depth of the seam beneath the surface. This would imply an angle of draw of $26\frac{1}{2}°$, whereas in practice a draw of 20° is about the maximum, so that most engineers will agree that the Committee has erred on the side of excessive caution.

On the question of wayleaves the Committee has merely repeated the conclusion of the 1883 Royalties Commission, to the effect that mineral owners unfairly debarred from a means of access ought not to be left without remedy. This conclusion has been inoperative for thirty-five years, and is likely to remain so; what is really required is something more definite and much stronger. At present wayleave rates are determined by the needs and means of those working the minerals, and not by the injury done to the landlord. What is really required is a statutory enactment that wayleaves shall in all cases be assessed by an independent tribunal, the measure of the payment to be made therefor being the damage suffered by the lessor granting the wayleave.

The all-important question of the cost of production receives but little assistance from the labours of the Committee; the very serious position is revealed that, whereas ten years ago the output of coal per worker employed was greater in this country than in Germany, to-day the reverse is the case, and the German miner is actually producing more coal per head than the miner in this country. The Committee is necessarily powerless in this matter, which depends essentially upon the coal-miner himself and his trade-unions, but the conclusion of the Committee on this subject deserves unqualified endorsement:—"It is only by increased production per head of the persons employed that our trade position can be maintained, and that improved conditions of employment can be secured, and this ought to be recognised by workmen as well as by employers."

One of the most interesting documents in the report is a letter from Mr. Robert Smillie, president of the Miners' Federation of Great Britain. The Committee strongly recommends the formation of a Ministry of Mines, a recommendation in which the majority of those interested in the mining industry will heartily agree; and Mr. Smillie wants not only such a Ministry, but further wants "the State to have the ownership and full control of the mines, not only on the productive side, but on the commercial side also." No doubt it would be a fine thing for a brief while for the coal-miners and their trade-unions if the State worked the collieries, and a compact and powerful body of voters like the coal-miners could no doubt dictate its own terms of employment; but this could not be except at the expense of the nation as a whole, and could last only until the increasing cost of coal involved the whole nation, and with it the miners and the mining industry, in universal ruin. The classical example of a State-worked coalfield is Saarbrücken, and everyone knows that the working of this field has cost the Prussian Treasury vast sums of money, operations having been carried on at a heavy loss, whilst the privately worked Westphalian coalfields made huge profits, and yet conditions of employment were better in the latter coalfield, and the price of coal to the general public was actually lower!

It is grossly unfair to suggest that British colliery proprietors have been unmindful of the safety of mine-workers. Every real improvement in the safety of coal-mining—*e.g.* the safety lamp, safety explosives, stone-dusting, prevention of gob-fires—has in every single case been due directly to researches undertaken at the instance, and paid for out of the pockets, of the colliery proprietors, whilst the State has done nothing at all. It is doubtful whether any one of these life-saving discoveries and inventions would be in existence to-day had collieries been worked by a red-tape Government Department instead of by enterprising individuals. Mr. Smillie does not suggest how the State is to obtain the ownership of the mining industry; he is far too shrewd to suppose that it could be done in any other than a perfectly equitable fashion, for he knows that our national credit, the most valuable asset we possess, is based essentially upon our reputation for fair dealing, and any action tending to tarnish ever so slightly our fair name would be a serious national calamity. It is, however, very clear that the nation cannot afford to purchase and work the coal-mines of the country; our financial position to-day is not so strong that we can venture to take upon ourselves further burdens, particularly when there is nothing whatever to be gained thereby.

H. Louis.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

On July 23, 1915, a scheme for the organisation and development of scientific and industrial research was presented to Parliament by the Board of Education, and we now have before us the third annual report.[1] The scheme involved the formation of a Committee of the Privy Council with an Advisory Council composed of eminent scientific men and men actually engaged in industries dependent on scientific research. Of the first Advisory Council three valuable members, namely, Prof. Meldola, Mr. W. Duddell, and Prof. Bertram Hopkinson, have been removed by death, and their places have been taken by Sir Maurice Fitzmaurice, the Hon. Sir Charles Parsons, and Prof. Jocelyn F. Thorpe. We are reminded by this report of the great extent of the field which the Committee has under consideration, and Appendix IV. shows the constitution of various Boards and Committees of Research. Of these the first and most important is the Committee of the National Physical Laboratory, and the others are occupied with fuel, food investigation, industrial fatigue, tin and tungsten, while Committees have charge of questions relating to glass and optical design, mine-rescue apparatus, building materials, lubricants, copper and zinc, engineering in its various departments, and the chemistry of food and cooking. The establishment of a fuel research station is a matter of great national importance, and some questions relating to coal and coal-mining have already received preliminary consideration elsewhere. The large-scale experiments on coal-dust explosions initiated at Altofts some years ago have led to important results which will presumably be recognised by the Committee. The inquiry into the Irish peat question will also claim further consideration.

An interesting feature of the report is an account of the progress made in the establishment of industrial research associations of manufacturers under the Companies Acts, working without distribution of profits and limited by a nominal guarantee. Parliament has voted a sum of one million in aid of researches approved during the next five years, and the Department of Scientific and Industrial Research has already guaranteed to the British Scientific Instrument Research Association an expenditure of 36,000*l.* within that period. A grant of 1500*l.* a year has been assigned to the British Photographic Research Association, and a yearly contribution of pound for pound to the forthcoming British Cotton Industry Association has been promised. Similar terms are offered to the proposed British Research Association for the Woollen and Worsted Industry on condition that the subscriptions from the firms reach in each case an annual sum of at least 5000*l.* Altogether some thirty industries are already engaged in preliminary work for the establishment of research associations.

The Iron Manufacturers' Research Association, founded by the British iron-puddlers, has set the good example of determining to investigate its own problems at its own expense, and by avoiding any claim on direct Government assistance in its finance it avoids that measure of regulation which is inseparable from the enjoyment of Parliamentary funds. It is not unlikely, and it is to be hoped, as the Advisory Council remarks in the report, that this example will be followed by other industries. Ultimately no doubt the great majority of research associations will become independent of direct State aid.

An important part of the work undertaken by the Advisory Council is the consideration of the problem how best to assist and encourage research workers and students. Grants have been made during the academic year 1917–18 to fifty-eight persons described as students, research assistants, or research workers, and the Council expresses satisfaction with the work done. It refrains from adopting any formal scheme until further experience has been gained, but in connection with provision for the future attention is again directed to the recently issued report[2] of Sir J. J. Thomson's Committee, and in particular to the fourth section, which deals with the supply of trained scientific workers for industrial and other purposes. The deficiency of recruits for the scientific professions and industries is so great that nothing short of far-reaching educational reform will provide a remedy. More time must be given to fundamental scientific subjects in the schools, especially the secondary and high schools; more help must be given to promising pupils, and attention may again be directed to the fact that there is nothing in scientific studies, theoretical or practical, which should deter girls from following such pursuits with a view to a professional career. But it must be understood that the pursuit of physical or natural science with practical ends in view is little, if any, less arduous than the training necessary for the medical profession. This, however, the last fifty years of experience have led women fully to recognise.

The report under notice is full of encouragement. British manufacturers are beginning seriously to believe in the association of science with industry, and we may look forward hopefully to the day when they will pursue their respective lines of research independently of the artificial stimulus derived from Governmental suggestion and support. In the meantime, it is to be hoped that pure science will not suffer neglect. The naturally inspired worker will generally be found to prefer freedom from official control, but he will continue to need in many cases precuniary assistance, which has been derived in the past from the several research funds administered by special societies. Among these the Government grant distributed by the Royal Society is the most important, but the meagre 4000*l.* a year for the whole circle of the sciences ought soon to be substantially increased.

[1] Report of the Commitee of the Privy Council for Scientific and Industrial Research for the Year 1917–18. (Cd. 9144.) (London: H.M. Stationery Office.) Price 4*d.* net.

[2] See NATURE for April 18, 1918, p. 135

NOTES.

WE notice with much regret that among the victims of the sinking of the Irish mail-boat *Leinster*, which was torpedoed by a German submarine on October 10, was Sir W. H. Thompson, K.B.E., King's professor of Institutes of Medicine, Trinity College, Dublin, and scientific adviser to the Ministry of Food.

DR. RAYMOND PEARL has resigned his position of biologist of the Maine Agricultural Experiment Station, Orono, Maine, having been appointed professor of biometry and vital statistics in the school of hygiene and public health, Johns Hopkins University.

A BRANCH of the National Union of Scientific Workers was formally constituted at Liverpool at a meeting held at the University on October 10. The branch resolved to give general support to any schemes of federation of existing organisations of workers in science and technology, and decided on representation at the general meeting of the union.

PROF. W. A. BONE, with the concurrence of the authorities of the Imperial College of Science and Technology, has asked to be relieved of his duties as consultant to the Fuel Research Board on October 22, in order to be free during the coming winter to devote his attention to plans now under consideration for the post-war development of the department of chemical technology at the college.

THE American Academy of Medicine is offering a prize to be awarded in 1921 for an essay from a fund raised in honour of Dr. C. McIntire, who for the period of twenty-five years was secretary of the academy. The subject of the essay is, "What Effect has Child-labour on the Growth of the Body?" and the competition is open to all. The essays must reach the Secretary of the American Academy of Medicine by, at latest, January 1, 1921.

THE Tin and Tungsten Research Board of the Department of Scientific and Industrial Research invites proposals from firms and individuals in a position to undertake research work with the view of increasing the extraction of tin and tungsten from Cornish ores by the introduction of improved processes. Letters in connection with the announcement should be addressed to the Secretary of the Tin and Tungsten Research Board, 15 Great George Street, Westminster, S.W.1.

WE regret to note that the death of Mr. John Paul Wilson is announced in *Engineering* for October 11. Mr. Wilson was the late general manager of Palmer's Shipbuilding and Iron Co., Jarrow-on-Tyne, and was seventy-two years of age at the time of his death, which took place on October 4. He had a long and varied experience in shipbuilding on the Clyde, at Barrow, and on the Tyne, and for a time was shipbuilding director of the Anglo-Spanish yard at Bilbao, which yard he designed and laid out to build 7000-ton armoured cruisers in an unprecedentedly short time.

BY an Order of the Minister of Munitions, dated October 11, on and after October 21 no clinical thermometer can be sold which does not bear the approval mark of the National Physical Laboratory. Up to one month from the date of the Order the laboratory will approve thermometers which show no error exceeding 0·4° F. over the scale below 100° F., and after that date such as show no error exceeding 0·2° F. over that range. The charge for testing the thermometers will be 3*d*., and for a small additional charge a certificate giving details of the results of the test of an instrument will be issued.

SEVERAL letters have reached us referring to Lord Walsingham's suggestion (NATURE, September 5, p. 4) that species proposed in the German language should not be regarded as valid. We do not think any useful purpose would be served by a general discussion of this subject, or by anticipating the confusion in nomenclature which, Dr. W. E. Hoyle points out, would result in the future if it be carried into effect. In the interests of scientific system, Dr. Hoyle suggests that before it is acted upon the proposal should be submitted to the International Commission on Zoological Nomenclature, which was specially established to deal with such question.

THE death is announced, in his sixty-ninth year, of Dr. William Kent, who from 1903 to 1908 was Dean of the College of Applied Science at Syracuse University, U.S.A. From 1877 to 1879 Dr. Kent was editor of the *American Manufacturer and Iron World*, from 1895 to 1903 associate editor of *Engineering News*, and from 1910 to 1914 editor of *Industrial Engineering*. He was vice-president of the American Society of Mechanical Engineers from 1888 to 1890, and in 1905 was president of the American Society of Heating and Ventilating Engineers. His publications included "The Strength of Materials," "Strength of Wrought-iron and Chain Cables," and "The Mechanical Engineer's Pocket-book."

ACCORDING to the *Times*, news has reached Vardö that Capt. Roald Amundsen's Polar expedition in the *Maud* passed Yugor Strait on August 28 and entered the Kara Sea. As was anticipated from previous experience, September proved to be a good month for crossing the Kara Sea. The *Maud* met with no difficulties, and was last heard of by wireless telegraph from Dickson Island at the mouth of the River Yenisei, where she took on board a quantity of petrol and sailed eastward. The expedition has now left the last outpost of civilisation, and, unless news is received from wandering natives in the Taimir peninsula or around the Lena delta, nothing will be heard of the *Maud* for several years.

THE Commonwealth Government has now published the official report by Capt. J. K. Davis on the *Aurora* relief expedition to the Antarctic. It will be remembered that the *Aurora* was sent to the Ross Sea to rescue the ten members of the Shackleton expedition left at Cape Evans. The task was accomplished with Capt. Davis's usual skill in handling his ship in difficult ice conditions. Unfortunately, three members of the expedition had lost their lives during the previous winter—Capt. Mackintosh and Messrs. A. P. Spencer-Smith and V. G. Hayward. The *Aurora* left Port Chalmers, N.Z., on December 20, 1916, and returned to Wellington on February 9, 1917, thus making a record voyage to the Antarctic and back. The voyage was, on the whole, uneventful, and no new discoveries were made. A track-chart of the journey accompanies the report.

THE first of three Chadwick public lectures on "The Story of a New Disease" was delivered by Dr. F. G. Crookshank on October 10. The subject is the Heine-Medin disease or infantile paralysis, which may assume various forms. The recent cases of so-called botulism (see NATURE, vol. ci., pp. 170 and 209) are probably examples of a cerebral form of it. Dr. Crookshank reviewed the history of various mysterious outbreaks of sickness with nervous symptoms recorded since the fifteenth century, and suggested that the key to the understanding of these diverse nervous epidemics is to be found in the description by Willis in 1661 of an "epidemical feavour, chiefly infestous to the brain and nervous stock." This is to be considered in the next lecture on Thursday, October 17, at 5 p.m. (11 Chandos Street, W.1, admission free).

A COMMITTEE has been appointed by Mr. Walter Long to investigate the available sources of supply of alcohol, with particular reference to its manufacture from materials other than those which can be used for food purposes, the method and cost of such manufacture, and the manner in which alcohol should be used for power purposes. The members of the Committee are as follows:—Sir Boverton Redwood, Bart. (chairman); Major Aston Cooper-Key, C.B. (Home Office); Mr. Arnold Philip, Admiralty chemist (Admiralty); Mr. H. F. Carlill (Industrial Power and Transport Department, Board of Trade); Prof. C. Crowther (Board of Agriculture and Fisheries); Dr. J. H. Hinchcliff (Department of Agriculture and Technical Instruction, Ireland) (Irish Office); Sir Frederick Nathan (Ministry of Munitions); Mr. H. W. Garrod (Ministry of Reconstruction); Sir H. Frank Heath, K.C.B. (Scientific and Industrial Research Department); Sir Frederick W. Black, K.C.B.; Prof. Harold B. Dixon, F.R.S.; Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S.; Dr. W. R. Ormandy; Mr. E. S. Shrapnell-Smith, C.B.E. (Deputy Director of Technical Investigations in H.M. Petroleum Executive); and Mr. Horace Wyatt (Imperial Motor Transport Council). Mr. Shrapnell-Smith will act as secretary to the Committee, and all communications should be addressed to him at the office of H.M. Petroleum Executive, 12 Berkeley Street, W.1.

WE regret to notice the announcement of the death in France of Lieut. P. M. Chadwick, R.E. Lieut. Chadwick was the son of Mr. and Mrs. Ellis Chadwick, of Parkstone, Dorset, and after a successful career at the City of London School and the Imperial College of Science and Technology, graduated B.Sc. in engineering. He then became in succession an articled pupil of Mr. Bailey Denton, assistant to the chief engineer of the new docks at Southampton, a lecturer at the City and Guilds Technical College, Finsbury, and finally a lecturer in civil engineering in Birmingham University. At Birmingham, under the direction of Prof. F. C. Lea, he made a critical examination of experimental data on the action of centrifugal pumps, and in a paper (published in *Engineering*) he attempted to express the results in the form of a characteristic equation. This work gained for him the James Forrest medal and the Miller prize of the Institution of Civil Engineers and the silver medal of the Birmingham Society of Engineers. He then proceeded to an original experimental investigation of the pressures in centrifugal pumps with the object of testing the theory, embodying the results in a thesis for which he was awarded the degree of M.Sc. in Birmingham University. At the outbreak of war he joined the Birmingham University O.T.C., and in 1915 was given a commission in the East Anglian Divisional Engineers. He saw service with the 54th Division in Gallipoli, and later in France.

THE Tokyo Society of Naval Architects has recently (July, 1918) published the second part of Mr. Shinji Nishimura's "Study of the Ancient Ships of Japan." It deals with the *Hisago-Bune* or "gourd ship." From a comparative study of Japanese and Korean myths and legends, and of the survival of the use of the [illegible] by certain women who fish for "ear-shells" on the coasts of Korea, Japan, and Chyoi-jyn Island, Mr. Nishimura arrives at the conclusion that in ancient times gourds were used as floats by swimmers and for rendering rafts buoyant. He insists upon the essential identity of these practices with the customs which still persist upon certain of the rivers of India and Mesopotamia, and suggests that the Japanese and Korean "gourd ship" is the Far Eastern modification of a device originally invented upon the banks of the Tigris and Euphrates. The influence of Indian and Egyptian methods of shipbuilding in eastern Asia has long been recognised; and it is of special interest to note that Babylonia has added a definite contribution to this easterly drift of sea-borne culture.

A "RADIOLOGICAL aeroplane" was described by Drs. Nemirowski and Tilmant before the Academy of Medicine of Paris at a meeting on September 3. It contains three places for the pilot, surgeon, and radiographer, and is provided with a generator for Röntgen-rays, one operating-table for operations performed with the aid of the rays, surgical instruments, and medicaments. The "Aerochir," as it is called, is intended to fly over the lines of action, ready to alight and render first aid to the wounded. The invention should be invaluable, provided, however, that it is not regarded by the enemy as a target for his fire.

IN continuation of his "Studies in Paleopathology," Prof. Roy L. Moodie cites numerous cases in which the condition known medically as opisthotonos appears to have set in at the time of death of fossil vertebrates (*American Naturalist*, vol. lii., p. 384, 1918). Some very familiar specimens, such as the Berlin Archæopteryx and the one complete example of Compsognathus, are included. The tetanic spasm has given "a peculiar curve to the backwardly bent neck" in these and other cases. The whole attitude of Osborn's *Struthiomimus altus* in the American Museum, including the contracted toes, provides a powerful example of this contention. The author urges that while some cases may merely represent the final struggle before the moment of death, others strongly suggest a cerebro-spinal or other intracranial infection.

IT is well known that the late Prof. Adam Sedgwick held somewhat unusual views with regard to what is commonly known as the "cell theory," and that these views were largely derived from his own investigation of the early development of *Peripatus capensis*. He maintained that in the young embryo the cell-boundaries were not properly defined—in fact, that the embryo formed a kind of syncytium with embedded nuclei. The precise knowledge which we already possessed of the segmentation of the egg and the formation of the germinal layers in other animals, even at the time he wrote, rendered it highly improbable that Peripatus formed an exception to the general rule; and Miss Edith H. Glen has rendered good service in demonstrating that Sedgwick's observations were inaccurate, and that, by appropriate methods, cell-boundaries can be demonstrated in the early embryo of *Peripatus capensis* as in other cases. Miss Glen's paper, published in the *Quarterly Journal of Microscopical Science* (vol. lxiii., part 2), also refutes Sedgwick's views as to the nature of the nephridia in Peripatus, and confirms the statement of Kennel that, as in the Annelids, they are of ectodermal origin.

IN vol. lxvii. of the *Archives Italiennes de Biologie* Major Gemelli, director of the psycho-physiological laboratory at Padua, gives an interesting account of the methods employed by the Italian authorities in the selection of aviators. As regards the psychological aspect, these are more elaborate than those employed in this country. In addition to the determination of reflex times to visual, auditory, and cutaneous stimuli by the usual methods, a method is employed by which the subject must perform appropriate movements according to the nature of the stimulus given. Graphic records of "emotive reactions" are also taken by means of the pneumograph. In addition, the power of attention, judgment, and observation are tested. Results are also given of observations upon the pulse-rate, arterial pressure, and respiratory rate. These results are generally in accordance with those noted by other observers. As regards the pulse-rate, this is found to accelerate with increasing altitude, but to remain approximately constant while at a certain height. During descent there is at first a slight augmentation of rate, followed by a gradual diminution, but on landing there is always an increased rate compared with that at the beginning of the ascent. In regard to the arterial pressure, it is found during ascent that the systolic pressure first falls slightly and then rises, while the diastolic pressure gradually falls; during descent the systolic pressure falls, while the diastolic pressure again rises. After a flight there is always a hypotension. In rate, respiration follows the pulse, but to a less degree. The author has also made investigations in regard to the composition of the blood of aviators. He has observed an augmentation of the hæmoglobin index and of the number of red corpuscles in most pilots of long experience. As regards the rather vexed question as to whether this is due to a concentration of the blood or to the new formation of red corpuscles, the author inclines to the latter view.

An abnormal change of air-temperature at Tokyo and Sinagawa on March 20 last is dealt with in the Journal of the Meteorological Society of Japan for August, 1918, by Kôsaku Sigetomi. At Tokyo the thermograph showed a rise of temperature amounting to 6·1° F. in twenty minutes, followed immediately by a sudden fall of 3·8° F. in the next ten minutes, and at the same time at Sinagawa, about $5\frac{1}{2}$ miles south of Tokyo, the air-temperature rose 14° F. in fifty minutes. Such an abrupt change of temperature in so short a time is said to be rare, and on December 19, 1912, the amplitude is said to have been 17·6° F. in about twenty minutes, but it is not noted whether the change was a rise or fall. A weather-chart is given for 2 a.m. March 20 to explain the change of temperature, and it is attributed to the presence of a cyclonic disturbance over the Japan Sea and to the passage of secondary disturbances in the south-western quadrant of the parent disturbance. A diagram is also given showing the records of the thermographs at several stations, with the wind directions at each hour, which shows very different results for stations in the north and in the south of Japan. The movements of cyclonic disturbances in Japan are similar to those followed in the British Isles, and subsidiary cyclonic disturbances are clearly subject to the same laws. In March the normal winds are northerly, with a high barometric pressure over Asia and a low pressure in the North Pacific. Charts for the period dealt with have not yet been received in this country, so that the details given cannot be easily followed or criticised. The occurrence is somewhat similar to the changes of temperature not unusually experienced in parts of the British Isles when a "V"-shaped depression or a line-squall is passing over the country.

According to a Press dispatch from Amsterdam (quoted in *Engineering and Mining Journal*, August 10), the discovery that Germany does not hold a world-monopoly of potash comes as a great blow to those economists who thought that Germany could impose her own terms for the supply after the war. The Government has just presented a report to the Reichstag pointing out that Spain has unexpectedly entered the market as a large producer of potash, and urging the German mineowners to organise their forces to meet the new situation.

The Austrian Treasury (according to a report in the *Zeitschrift des Oesterreichischen Ingenieur- und Architekten-Vereines*, July 26) has decided to continue the investigations on a large scale into the occurrence of mineral oil and natural gas in Hungary, as the experiments recently made with the Eötvös torsion pendulum have given encouraging results. A large sum has been set aside for the work, which will be carried out by a number of geophysicists. The whole of Hungary will be systematically investigated from the point of view of the occurrence of mineral-oil deposits.

New regulations have been issued by the Physikalisch-Technische Reichsanstalt (*Elektrotechnische Zeitschrift*, July 4) regarding the testing of electrical meters. The complete outfit consists of transformers and one or more meters. During the testing of the instruments all auxiliary apparatus (power, current, voltage indicators, relays, etc.) that are to be actuated by the transformer in practice must be connected up or replaced by substitute resistances and coils with the correct energy consumption and power factor. If the secondary leads of a current transformer exceed 0·15 ohm, an equivalent resistance must be inserted during test.

Carl Goldschmidt discusses in *Technik und Wirtschaft* for August the question of the more thorough utilisation of the by-products of coal and lignite in gasworks, slow-combustion plants, extracting plants, etc. He points out that many of the valuable "key" products akin to naphtha are wholly or partially wasted in the processes at present in use. By proper thermal treatment of lignite in suitable plant and the subsequent careful treatment of the resultant products, it should be possible to secure even greater independence of foreign sources of supply of lubricants and of burning and lighting oils in the future.

La Nature of August 24 contains an interesting account of the recent discoveries in the so-called Lyons coalfield, which is, in effect, a concealed extension of the Saint Etienne coalfield on the left bank of the Rhone, south of Lyons. Whilst the first attempts to prove this area date back so far as 1855, it is only within the last few years that the existence of workable seams has been successfully demonstrated. The various borings are described in some detail in the original paper. The results show a long, narrow coalfield or, possibly, a string of small basins. The seams are narrow and the coal measures relatively deep, probably in some cases more than 2000 ft. below the surface. The coal is, however, a gas-coal of excellent quality, and the geographical position of the field, close to an important industrial centre like Lyons, is much in its favour. So far it is not supposed that the output is likely to exceed greatly one million tons per annum. There are, furthermore, indications that oil-shales may also exist in this field.

We have received from the Board of Agriculture a copy of the Food Production Leaflet No. 53, which deals with the storage of sulphate of ammonia on farms. It is pointed out that, whether the sulphate is stored in bags or loose in a heap, the building in which it is kept should be dry and an efficient protection from rain. Sacks of sulphate of ammonia should be piled on a platform raised 6 in. from the floor, a 3-in. layer of some dry substance being placed beneath the platform to absorb any moisture draining from the sacks. The dry substance may be either castor-meal, rape-meal, bone-flour, or raw-bone meal (which can be afterwards used as fertilisers), but chalk, lime, or basic slag must not be used, as they would liberate ammonia from the sulphate. When the sulphate of ammonia is to be stored in a heap, the floor should first be covered to a depth of 6 in. with one of the absorbent substances mentioned above (failing these, a layer of dry soil, sand, or sawdust may be used). Before being applied to the land the sulphate should be freed from lumps, and may with advantage be passed through a ¼-in. riddle. This will not be necessary in the case of "neutral" sulphate (*i.e.* containing less than 0·025 per cent. of free acid), which contains no lumps and does not cake. Farmers are recommended to secure the neutral sulphate wherever possible, as this does not rot the bags, and can, moreover, be applied to the land through a drill.

THE re-awakening of interest in Canada in the shipbuilding and engineering industries some years ago came at an opportune time, in view of the world-war, and the various establishments organised are doing most useful service, both in the production of ships and in the supply of munitions. One of the leading establishments is that of the Canadian Vickers at Montreal, and these works form the subject of articles in *Engineering*, the first of which appeared in the issue for October 11. These works were started in 1910, and had attained full influence on the shipbuilding resources of Canada in 1915. The illustrations of the produce of the yard, which covers thirty-five acres, deal almost exclusively with merchant shipbuilding and high-speed motor-boats, of which a great fleet has been built. The company has also manufactured a large number of projectiles. The great floating dock, which forms such an interesting feature of the establishment, was roofed in so as to provide a workshop for the building of motor-boats, and thirty boats could be in progress simultaneously within the dock, while others were built in other departments on the shore. The transporting of the boats overland to a convenient Atlantic port was accomplished by loading them on exceptionally long and well-trussed trucks, with a four-wheeled bogie at each end, the bow and stern of the boat overhanging. It is not permitted, meanwhile, to enter into details of these boats.

BULLETIN No. 2 of the Department of Scientific and Industrial Research, which deals with cutting lubricants and cooling liquids, and with the skin diseases caused by lubricants, should prove very useful to engineers, although it contains no new work. The information comprised in the first part of the bulletin has been collected by Mr. T. C. Thomsen, who divides cutting lubricants and cooling liquids into the four classes: (1) Soluble oils which form an emulsion when mixed with water, (2) soluble compounds (or cutting compounds), *i.e.* greasy compounds which emulsify with water, (3) cutting emulsions formed by mixing either soluble oils or soluble compounds with water, and (4) cutting oils such as lard-oil, rape-oil, mineral oils, or a mixture of these. The principal uses of these classes of substances are: (*a*) Cooling, (*b*) lubrication, (*c*) to produce smooth finish, (*d*) to wash away chips, and (*e*) to protect from rust or corrosion. Efficient cooling of the tool edge reduces the wear and increases output; it is most apparent with high-speed steel. Lubrication is of little importance in cutting brittle material, but very important where the metal is tough. If cooling and lubrication are efficient, a good finish will result. To produce a perfect finish, cutting oils of great oiliness must be applied. The washing away of chips is frequently an important function, and if the cutting emulsion is too weak it will not be efficiently performed. The important factors to be considered in the selection of cutting lubricants are cutting speed and depth of cut, the material employed, the system of application, and the production of skin diseases. The latter are dealt with by Dr. J. C. Bridge, who describes them as of two kinds: (*a*) Plugging of the glands of the hair follicles, and (*b*) mechanical injury of the skin by metallic particles. The first sets up inflammation round the hair (folliculitis) and may lead to suppuration. For prevention of the diseases cleanliness of the worker and frequent cleaning of the lubricant and machines are recommended. The addition of antiseptics to the lubricant has not proved altogether satisfactory, but it has been suggested to sterilise the cutting oil by heat.

WHEN a beam, the weight of which can be neglected, has one end built into a wall and the other end loaded, the flexure of the beam is accompanied by a twist of successive sections with respect to each other unless these sections are symmetrical. The relation between the flexure and torsion has been worked out for beams of certain simple sections by Mr. A. W. Young, Miss E. M. Elderton, and Prof. K. Pearson in a Drapers' Company research memoir recently published. Some of the conclusions have been verified experimentally, and the authors hope that the research will serve as a first step towards the understanding of the relation between flexure and torsion in propeller-blades.

AN article in NATURE of April 18 (vol. ci., p. 138), describing contributions in the Journal of the Scottish Meteorological Society, referred to a chart called a climograph, devised to give a graphic representation of the various climatic conditions. It was stated that "the idea originated with Prof. Huntington," but we learn that this is incorrect. The method is due to Dr. Griffith Taylor, of the Meteorological Bureau, Melbourne, and Prof. Huntington acknowledged its origin and value in a lengthy review in the *Geographical Review* (New York) for November, 1917.

MESSRS. HENRY HOLT AND CO. (New York) give notice of a book by W. Beebe—entitled "Jungle Peace"—resulting from the author's experiences whilst in charge of the tropical research station of the New York Zoological Society in British Guiana. It will be illustrated from photographs.

OUR ASTRONOMICAL COLUMN.

LARGE METEORS.—Dr. F. J. Allen writes from Cambridge that he observed a brilliant meteor on September 27 at 10.7 pass rather slowly across the eastern meridian in a nearly horizontal S. to N. direction at an altitude of about 60°. Another fine meteor was seen from London, W., at 10.15 on the same evening. Mr. Denning observed from Bristol on October 4, 8.43, a large meteor, brighter than Venus, travelling slowly from the N. region of Pegasus into Cygnus. The same object was seen at Totteridge, N., by Mrs. Wilson, and it seems to have been rather low in the atmosphere, the height being from 42 to 31 miles, and the length of path 44 miles. The radiant point was at 13°−10° near η Ceti. Bright meteors were also recorded at Bristol, and their paths noted as follows:—

		h.	m.	mag.	°	°		°	°	
Sept.	30	7	43	= ♃	325	+10	to	325½	+ 4	slow
	30	7	46	1	348½	+30		29	+37	,,
Oct.	1	10	30	1	70	+37		72	+32	swift
	6	10	45	1	26	− 9		33	−19	slow
	6	10	48	1	22	+42		22½	+49	,,
	8	8	4	= ♀	270	+73½		285	+78½	,,

Duplicate observations of any of these objects would be valuable in order to determine their real paths in the air.

OBSERVATIONS OF LONG-PERIOD VARIABLES.—The results of extensive observations of four long-period variables which have been made at Johannesburg are summarised by Mr. W. M. Worssell in Circular No. 42 of the Union Observatory. Formulæ for maxima and minima have been derived by including other available data, chiefly from observations at the Harvard College and Cape observatories. The names of the stars and formulæ for dates of maximum are as follows:—

R Horologii *025050*.
J.D. 2415220+400.4 E days; $M-m=174$ days.

RS Centauri *111661*
J.D. 2415024+164.2 E days + 14.5 sin (30+15 E)° days.

SV Scorpii *174135*
J.D. 2415259+258.4 E days; $M-m=148$ days.

RU Capricorni *202622*
J.D. 2415275+346.4 E days.

The numbers following the names of the stars give a rough indication of position; the hours and minutes of right ascension are indicated by the first two pairs of figures and the degrees of declination by the last pair.

CORRECTION OF APPARENT STELLAR MAGNITUDES.—In the Journal of the British Astronomical Association (vol. xxviii., p. 252) Mr. Felix de Roy directs attention to the importance of correcting estimates of stellar magnitude for atmospheric absorption. Tables are available which indicate the mean loss of light for an average star as a function of its zenith distance for a place of observation near sea-level. The mean absorption is under 0.05 mag. up to Z.D. 38°, reaches 0.1 at 47°, 0.2 at 58°, 0.3 at 64°, 0.4 at 69°, 0.5 at 72°, and then increases very quickly, reaching a whole magnitude at 80°, two magnitudes at 86°, and three magnitudes at 88°. With the aid of such a table, or a graph, it is easy to compute the apparent magnitude at a given time from the true (zenithal) magnitude as given in a catalogue. It is pointed out that the neglect of this correction may partly account for the discrepancies between individual estimates of the brightness of Nova Aquilæ during its brightest stages, as comparisons were necessarily made with stars at very different altitudes.

INTER-ALLIED CONFERENCE ON INTERNATIONAL SCIENTIFIC ORGANISATIONS.

THE following is a complete list of the delegates who attended the Inter-Allied Conference on International Scientific Organisations which was held at the Royal Society on October 9–11:—*British Delegates:* Sir Joseph Thomson, O.M., Sir Alfred Kempe, Prof. A. Schuster, Mr. W. B. Hardy, Prof. W. A. Herdman, Sir Frank Dyson, Mr. J. H. Jeans, Col. H. G. Lyons, Prof. C. S. Sherrington, Sir William Tilden, Sir Edward Sharpey Schafer, and Prof. J. A. McClelland. *Foreign Delegates.—Belgium:* M. Lecointe, Prof. Massart, and M. de la Vallée Poussin. *France:* M. B. Baillaud, M. G. Bigourdan, M. A. Haller, M. Lacroix, M. C. Lallemand, M. Moureu, and M. E. Picard. *Italy:* Prof. V. Volterra. *Japan:* Prof. Joji Sakurai and M. A. Tanakadate. *Serbia:* Prof. Bogdan Popovitch. *United States of America:* Dr. H. A. Bumstead, Col. J. J. Carty, Dr. W. F. Durand, Dr. S. Flexner, Prof. G. Hale, and Dr. A. A. Noyes. *Brazil:* M. Carlos de Carvalho.

The subjoined statement was adopted unanimously by the Inter-Allied Conference. It is intended to serve as a preamble to a number of resolutions dealing with the withdrawal of the Allied nations from existing international associations and the formation of new ones to take their place. The confirmation of the academies represented at the conference is required before the text of the resolutions can be made public:—

When more than four years ago the outbreak of war divided Europe into hostile camps, men of science were still able to hope that the conclusion of peace would join at once the broken threads, and that the present enemies might then once more be able to meet in friendly conference, uniting their efforts to advance the interests of science. For ever since the revival of learning in the Middle Ages the prosecution of knowledge has formed a bond strong enough to resist the strain of national antagonism. And this bond was strengthened during the latter part of last century, when branches of science developed requiring for their study the co-operation of all the civilised nations of the world. International associations and conferences rapidly multiplied, and the friendly intercourse between the learned representatives of different countries grew more intimate, in spite of their political differences, which were admitted but not insisted upon.

In former times war frequently interrupted the cooperation of individuals without destroying the mutual esteem based on the recognition of intellectual achievements; peace then soon effaced the scars of a strife that was ended. If to-day the representatives of the scientific academies of the Allied nations are forced to declare that they will not be able to resume personal relations in scientific matters with their enemies until the Central Powers can be re-admitted into the concert of civilised nations, they do so with a full sense of responsibility, and they feel bound to record the reasons which have led them to this decision.

Civilisation has imposed restrictions on the conduct of nations which are intended to serve the interests of humanity and to maintain a high standard of honour. Such are the recognition of the sanctity of treaties—especially those designed to apply to a state of war—and the avoidance of unnecessary cruelties inflicted on civilians. In both these respects the Central Powers have broken the ordinances of civilisation, disregarding all conventions, and unbridling the worst passions which the ferocity of war engenders. War is necessarily full of cruelties; individual acts of barbarity cannot be avoided, and have to be borne. It is not of these we speak, but of the organised horrors encouraged and initiated from above with the sole object of terrorising unoffending communities. The wanton destruction of property, the murders and outrages on land and sea, the sinking of hospital ships, the insults and tortures inflicted on prisoners of war, have left a stain on the history of the guilty nations which cannot be removed by mere compensation of the material damage inflicted. In order to restore the confidence without which no scientific intercourse can be fruitful, the Central Powers must renounce the political methods which have led to the atrocities that have shocked the civilised world.

THE JOHANNESBURG MEETING OF THE SOUTH AFRICAN ASSOCIATION.

THE sixteenth annual session of the South African Association for the Advancement of Science was held in Johannesburg from July 8 to 13, with Dr. C. F. Juritz as president. There were receptions and functions of the type inseparable from such occasions, besides visits to municipal undertakings, to iron and steel works, to gold mines, to power stations, and to the Zoological Gardens. Of even greater interest to many of the visitors were the Union Observatory, the South African Institute of Medical Research, and the Water Board barrage on the Vaal River, the third largest in Africa, that of the Assouan Dam being the largest.

Nearly ninety papers were read at the various sections, and the attendance was larger than it has been for many years past.

Prof. J. T. Morrison, as president of Section A, discussed in its broad aspects the subject of the internal structure of the earth. The discussion proceeded mainly along geophysical lines, and it was suggested that it is the function of the geophysicist to investigate the processes by which have been maintained those incessant movements whereof the geological record is a witness, at the same time so indubitable and so perplexing.

The address of Dr. P. A. Wagner, president of Section B, had as its subject "The Mineral Industry of the Union of South Africa and its Future." He said that the recorded output of the Witwatersrand mines had exceeded a total value of 571,000,000*l*., while for the single year 1916 the value reached was 38,492,000*l*. He estimated the gold still capable of being profitably recovered from the mines as worth 1,200,000,000*l*. The declared value of the country's diamonds had attained an aggregate figure of more than 216,000,000*l*. The coal industry was capable of considerable expansion, and the 1911 estimate, which placed the reserves at 56,000,000,000 tons, erred greatly on the conservative side. The dimensions of the country's future iron industry would depend on the rich titaniferous ores of the bushveld complex; of these more than 3,000,000,000 tons are computed to be available.

Mr. C. E. Legat, Chief Conservator of Forests of the Union, was president of Section C, and in his address dealt with the subject of the Union's forestry and timber supplies. There were, he said, two million acres of forest reserves in the Union, but only somewhat less than half a million acres of actual forest. When once the forests were in a normal condition—which would not be for a long time to come—the annual output of yellow wood would not exceed 1¼ million cubic ft.—a mere fraction of the Union's present requirements—and in fifty years' time these requirements would probably have doubled. Afforestation on a large scale is therefore essential; at least 300,000 acres of new coniferous plantations should be established, and 50,000 acres of hard woods.

In Section D the presidential office was filled by Dr. E. J. Goddard, professor of zoology in the University of Stellenbosch, and in Section E by the Rev. W. A. Norton, lecturer in Greek in the University of Cape Town. The latter urged the need of further research into things native, especially in comparative philology, language being the chief key to the psychology of a race, and psychology being necessary to their effective use, government, and education.

Dr. Thos. M. Forsyth, professor of philosophy in Grey University College, Bloemfontein, in his presidential address to Section F, discussed the relations between philosophy and science. He aimed at showing that it is the endeavour of philosophy, no less than that of science, to avail itself of the experimental method. The philosophical significance of scientific units and standards of measurement lies in the truth that only in our sense-impressions have we direct experience of reality—the reality which science seeks to interpret. The way to the union of scientific and philosophic points of view lies accordingly in further elucidation of the nature of immediate experience, and the derivation thence of the conceptions by which experience is explained. The feeling of our oneness with Nature leads science to seek to reduce mind to terms of matter, and philosophy to reduce matter to terms of mind.

One cannot well do more than touch lightly here and there upon some of the salient points in the many papers which occupied the attention of the sectional meetings. In Section A a great deal of interest was aroused by Prof. Schwarz's audacious scheme for the conversion of the Kalahari into permanent pasture-land by building two weirs at the Cunene and Chobe rivers. The paper was discussed at great length and severely criticised by engineers, meteorologists, geologists, and botanists alike. Mr. J. A. Vaughan, in the course of a paper on safety in winding operations, said that the four hundred main winding plants regularly at work on the Rand made an aggregate of 31,000,000 trips per annum, while the winding accidents amounted to sixty-two—equal to a rate of one accident per half a million journeys. Dr. Moir gave the section a description of his method of fitting an equatorial sundial at small cost so as to introduce compensations for the irregular solar motion and enable one to read correct time.

In Section B Prof. Rindl made some additions to his paper of last year on the subject of South African medicinal springs. Amongst the springs newly described some striking features were exhibited by those of the South-West Protectorate, which are of deep-seated origin, and, apart from geysers, belong to the hottest springs known.

The Rev. Dr. F. C. Kolbe read a paper before Section C on the function of experiment in the teaching of botany in schools. The school-teaching of botany, he considered, might very well do all it can with direct observation, leaving the experimental stage to the university. Some of the experiments usually performed in schools are not logically valid, while others usually failed, and so did more harm than good. Dr. E. P. Phillips described a botanical collecting trip in the French Hoek district, and showed how the character of the vegetation changed from the strongly xerophytic types at the foot of the mountains as one rose to a height of 4000 ft. On attaining a height of 2000 ft. to 3000 ft. the trees are replaced by dense, tall bush, which, 500 ft. to 1000 ft. higher, is in turn succeeded by scrub. Miss A. M. King gave a description of what may prove to be a new species of Balansia growing on *Cynodon dactylon* about Pretoria. Dr. Ethel Doidge announced the appearance of Californian walnut blight in the South African walnut plantations, and described the characteristics of the disease (*Bacterium juglandis*). In another paper Dr. Doidge attributed the prevalence of bean blight (*Bacterium phaseoli*) to the exceptionally wet season in the Transvaal last summer. Miss A. M. Bottomley gave a preliminary account of a severe outbreak of fungoid disease which had begun to show itself among young cypress plants three years ago; and Mr. V. A. Putterill described the morphology and life-history of the fungus which causes "rust" in aloes. Mr. A. O. D. Mogg discussed veld-burning in its relation to stock-diseases. Veld changes resulting from burning may so alter the whole ration-selections of the grazing animals that they may commence browsing on widely differing plants, formerly avoided, and often of an inimical character.

In Section D, Dr. Annie Porter read a paper on the occurrence of leuctogregarines in South Africa; two such occurrences—one in a dog and one in a rabbit—had been observed. Prof. Fantham recorded the presence of various parasitic protozoa in South African fishes and amphibians; and Dr. F. G. Cawston gave an account of the cercariæ which attack South African snails.

The Rev. H. A. Junod described before Section E the customs of the Baronga in relation to smallpox. They had practised inoculation with the virus for many decades, using the serous fluid invariably from children or from old people, *i.e.* from those who might be called asexuate. The Hon. Mr. Justice Jackson read a paper on the medicine-man in Natal and Zululand. Unqualified men are allowed to practise on payment of a fee, and more than 1400 of these men have taken out licences. Dr. J. B. McCord also contributed a paper on Zulu witch-doctors and medicine-men, and described some startling surgical operations performed by these with no better instrument than a piece of broken glass. The Rev. J. R. L. Kingon spoke on unrealised factors in economic native development. He showed what profound changes had come about as a direct result of the use of certain implements, both of peace and war: the poisoned arrow and the assegai, the plough and the wagon, the primitive sledge contrasted with the railway, had each in turn exercised important effects in tribal life, and an axe had been the cause of a war. Mr. J. D. Marwick dealt with the important subject of the natives in the large towns. He uttered a warning regarding the growing tendency of the younger natives to form bands for the practice of crime and vice. Dr. C. T. Loram offered some practical suggestions for better provision for the medical needs of the natives; and two very interesting contributions were made by Mr. J. McLaren, one on Xosa arts and crafts, and the other on Xosa religious beliefs and superstitions. Of absorbing and unique interest was an account given by Dr. C. Pyper of the engraved (cup- and ring-marked) stones of the Lydenburg district in the North-Eastern Transvaal. Mr. W. Hammond Tooke discussed the problem of the Rhodesian ruins, and entered the lists against the views expressed on a former occasion by the Rev. S. S. Dornan. The latter gentleman also contributed a paper on the killing of the divine king in South Africa; the practice is founded on the belief that the potentate, in order to retain his divinity, must die a violent death as soon as senile decay sets in, lest the divine spirit should likewise suffer decay.

Before Section F, Mr. R. T. A. Innes initiated a discussion on the desirability of giving direct representation in the Upper House of the Union Legislature to education, agriculture, manufacture, mining, law, health, commerce, and finance. Purpose in education was discussed by Mr. H. C. Reeve; its ultimate aim should approximate towards the definite ideal of happiness for all. The demand for vocational training, so insistent of late, consequent on over-emphasising production, has revealed a lack of clear thinking, and the first need is, therefore, for leaders of thought to acquire definite views regarding education's ultimate aim.

On the first evening of the session, after the conclusion of the president's address in the Selborne Hall (see NATURE of September 19), Dr. Juritz presented to Mr. R. T. A. Innes, Union Astronomer, a cheque for 50*l.* and the South Africa medal annually awarded in recognition of achievement and promise in connection with scientific research in South Africa.

The 1919 session of the association will be held at Kingwilliamstown, with the Rev. Dr. W. Flint as president.

REPORT OF THE SURVEY OF INDIA.

THE report issued by Col. Sir S. G. Burrard, the Surveyor-General of India, for the year 1916–17 includes a most satisfactory record of work accomplished in spite of a depleted staff and the difficulties involved by war exigencies. It is gratifying to observe how this Department has responded to the call of the war; the list of honours awarded to its members for distinguished service in the field is one of which any department might well be proud. Survey detachments have been sent to Mesopotamia, Western Persia (with the Russian forces), Persia (generally), Salonika, Waziristan (with the Field Force), and to the Makran border mission. Not a word is said about the work accomplished by these military parties, but quite enough is known, independently of the report, to justify the statement that they have well maintained the reputation of Indian surveyors in the field of military action. We shall hear all about them in time, though probably not from India. The normal work of the Department has been well sustained, especially in the topographical branches, where good progress towards the completion of the 1915 scheme is recorded. Broadly, this scheme embraced a re-survey of India (of which the topography was then nearly complete, but much out of date) on the scale of 1 in. per mile, with a subsequent very wise reservation in favour of ½ in. per mile for certain extensive but unimportant areas of wilderness and jungle. The whole output for the year amounts to about 33,000 square miles (still leaving 1,350,000 to be completed) at an approximate cost of 31.4 rupees per square mile (say 2*l.*). Certain small areas of forest on scales of 3 in. and 4 in. per mile are included, so that this output of the twelve small parties employed must be considered very satisfactory. The geodetic operations include (besides direct triangulation and the magnetic surveys) pendulum, tidal, and levelling observations of great scientific value. More than one million maps have been turned out in the map department, including topographical, geographical, and general maps, amongst which are twelve sheets of the "one millionth" map of the world, which are now reduced to uniform style so as to take their place with similar sheets of the series published by the Royal Geographical Society and elsewhere. The colour system adopted by the Survey of India for defining differential altitudes in planes of different tints is not beyond criticism. The highest altitudes (next the regions of perpetual snow) are coloured a blood-red. The result when applied to Tibet is almost comic in its blazing determination to secure due recognition for the "Roof of the World."

T. H. H.

PHYSICS IN RELATION TO NATIONAL LIFE.[1]

ABOUT one hundred years ago—in the year 1808—Dr. Thomas Young, one of the greatest of English physicists, published his "Lectures on Natural Philosophy." They had been delivered a short time

[1] From a lecture delivered on April 27 by Sir Richard Glazebrook, C.B., F.R.S., in a course on "Science and the Nation," arranged for science teachers by the London County Council Education Committee.

previously at the Royal Institution, and are a storehouse of physical science as it was then known. In his introduction he says:—"The dissemination of the knowledge of natural philosophy and chemistry becomes a very essential part of the design of the Royal Institution, and this department must in the natural order and arrangement be anterior to the application of the sciences to practical uses. To exclude all knowledge but that which has already been applied to immediate utility would be to reduce our faculties to a state of servitude and to frustrate the very purposes which we are labouring to accomplish. No discovery, however remote in its nature from the subjects of daily observation, can with reason be declared wholly inapplicable to the benefits of mankind."

The lectures cover the whole range of physics as it was then known, and in the last, the sixtieth, the author concludes:—"When we reflect on the state of the sciences in general at the beginning of the seventeenth century and compare it with the progress which has been made since then in all of them, we shall be convinced that the last two hundred years have done much more for the promotion of knowledge than the two thousand which preceded them, and we shall be still more encouraged by the consideration that perhaps the greater part of these acquisitions have been made within fifty or sixty years only. We have, therefore, the satisfaction of viewing the knowledge of Nature, not only in a state of advancement, but even advancing with increasing rapidity."

Dr. Young lived one hundred years ago, and if then these words were true, how much more true are they to-day! The rate of growth of our knowledge of inanimate Nature in the past twenty years or so has far surpassed anything he ever contemplated, and the benefits that growth has brought mankind far exceed all he ever dreamed of. Not that they are all benefits; the terrors of war, the sufferings of the innocent, the poison-gas shell, the bomb that kills women and children, and the nameless horrors Science has put it into the power of human fiends to deal around forbid that comforting dream.

Still, there is no doubt which way the balance turns. Contemplate modern life without physics—the science of energy; think of it with our knowledge of electricity, what it was even when Young wrote, with the steam-engine almost a toy, with ships dependent still upon the wind and tides, with the engineer compelled to use human labour, assisted only by the simpler mechanical devices, such as the inclined plane or some elementary arrangement of pulleys for his buildings and bridges.

Physics guides us in directing the national stores of energy into channels useful to man; it is to this power that man owes his supremacy over the brute creation, and it is to the discovery of those natural laws which are the subject of study of the physicist that this power is due. This statement of our subject is sufficient to indicate its extent. Clearly, to treat in turn of all its branches and indicate their connection with our national life is a hopeless task for an hour's lecture. There is not time to deal completely even with one, and yet I think some appreciation of what we owe to physical science may be gained if I attempt a very brief review of our knowledge of electricity one hundred years ago and of its progress since that date.

The age was a fertile one. Cavendish was still working, and had discovered many of the laws of statical electricity; he had shown how to combine oxygen and hydrogen to form water, and had used the electric arc to produce nitrogen from the air.

On the Continent Coulomb had verified experimentally the inverse square law for electricity by the use of the torsion balance, and had investigated its distribution on conductors of various forms. Laplace and Poisson were active in applying mathematical calculations to problems in electrostatics, and somewhat later (1828) George Green, the self-taught mathematician—he was a Nottingham shoemaker who, after the publication of the paper referred to, entered at Caius College, Cambridge, became fourth Wrangler in 1837, and died in 1841—made by far the most important advance up to that date in electrical theory. The Leyden jar had long been invented, and some experiments had been made on currents produced by discharging a series of condensers (Leyden jars) through long wires or obtained through statical electrical machines; little was known of the properties of the current, because no means of producing continuous currents existed.

The science of magnetism was in a similar elementary condition. Gilbert, of Colchester, physician to Queen Elizabeth, in his treatise "De Magnete," published in 1600, had described the fundamental facts of the subject, and Coulomb had applied the torsion balance to prove the inverse square law for magnetism; there was a vague idea that there must be some connection between electricity and magnetism, but of electro-magnetism and all the vast possibilities it implied there was no conception. With the new century came a change, though even then progress, which to Young, writing in 1808, seemed rapid, to us seems slow.

In 1800 Volta invented the voltaic pile, a pile of discs of zinc and copper, alternately separated by flannel washers moistened with dilute acid; a considerable e.m.f., depending, of course, on the number of couples, is produced between the extreme discs, and a small current can be drawn from the apparatus. Then came his "crown of cups," the primitive form of battery, a plate of zinc and copper dipping into a vessel (a cup) filled with dilute acid, and connected by a wire outside the vessel; a number of these arranged in series formed the crown.

Twenty years later (in 1820) came Oersted's great discovery, described in his "Experimenta arca effectum conflictus electrici in acum magneticum," in which he described for the first time the action of a current on a magnet; the ordinary method of measuring a current by the deflection of a magnet was a natural result, and Schweigger invented the galvanometer, while Ampère with wonderful rapidity established elementary laws which regulate the action of one current on another, and laid the foundation of electrodynamics. In the same year Arago, followed in 1821 by Sir Humphry Davy, discovered independently the power of a current to magnetise steel. Arago's further discovery in 1824 of the rotation of a magnet when suspended freely over a rotating copper disc led ultimately to results of the very greatest importance, which culminated in 1831 in Faraday's discovery of the induction of electric currents and the elucidation of their laws.

The child was born whose birth was soon to be of such immense consequences to mankind, but probably no one, not even Faraday himself, realised all that was to follow.

In 1827 Ohm stated the law now universally known by his name, and its statement led to much important work with a view to its complete verification. The fundamental laws of electrolysis were enunciated by Faraday in 1833, and for long there was an ardent controversy as to the source of the electromotive force in a galvanic cell.

By the middle of the century the foundations of the science were well and truly laid; its influence on national life had until then been but small, but the ground was secured on which to build safely the structure of the practical applications of electricity. In the last seventy years theory has advanced no less than practice; indeed, as we shall see later, some of the most important recent practical advances are the outcome of very recent theory; but the fact remains that for real progress the practical application of a science must rest upon a secure basis of theory; only then will its progress be rapid and uninterrupted.

Ampère's experiments and Faraday's researches had indicated various methods by which motion could be produced owing to electro-magnetic action, or conversely, by which currents could be generated in conductors moving in magnetic fields, and as a result numerous inventors produced magneto machines. Faraday himself used one made by Pixie. In Saxton's machine, employed frequently towards the middle of last century, two coils wound round a soft iron armature rotate in front of the poles of a strong permanent magnet somewhat as is done in the spark magneto of the present day.

Werner Siemens in 1857 invented the Siemens armature; the next step was to replace the permanent magnets by electromagnets excited by a separate small machine. Wilde's machine (1867) was of this class, and in the same year Wheatstone and Werner Siemens enunciated the principle of the modern self-exciting dynamo, in which the remanent magnetism of the field coils is utilised to start a feeble current in the rotating armature; this current is led round the field coils, thus reinforcing their magnetism, and in this manner the powerful currents generated by modern machines are built up.

So far, the fundamental principles established by Faraday had been the basis of the work done. Various distinguished men contributed to advance the theory and to improve practice. About this time the Electrical Standards Committee of the British Association began its labours. Appointed at the instance of Lord Kelvin (Sir William Thomson) in 1861, during the period 1862–70 it made a series of reports which have been of fundamental importance in the theory and practice of electricity. It was re-appointed in 1881 at the suggestion of Prof. Ayrton, and continued to do useful work until 1913, when it was felt that the National Physical Laboratory was carrying out the duties for which it had been organised.

Lord Kelvin, in his work connected with the Atlantic telegraph, had realised very fully the need for a consistent system of units of measurement. Such a system had been proposed by Weber, and the committee in the end was led to adopt as fundamental the C.G.S. (centimetre-gram-second) system of units, and base on it the practical system of electric units—the ohm, the ampere, and the volt—now in use everywhere. It is impossible to overestimate the practical effects of this action. In the first place, electricians throughout the world speak a common language, and the results of researches are intelligible to all alike; in the second, that language is a consistent and logical one, electrical quantities are connected together and linked with the fundamental conception of energy in the simplest manner possible, and in a way which permits of accurate numerical calculation.

As a result of the labours of the distinguished men who formed the committee and their colleagues at home and abroad, we had the means of measuring with high accuracy current, electromotive force, and resistance, together with a number of other dependent electrical quantities.

Another step was needed to complete the theory of the dynamo: to permit the manufacturer to design on scientific principles a machine which for a given speed of rotation would transform mechanical into electrical energy at any required rate in the form of a given current at a known voltage.

The laws of magnetic induction in iron and steel were known but very imperfectly. As has already been stated, Arago and Davy had discovered in 1820 that iron was magnetised by a current; Poisson and others had given theories of this induced magnetism; Kelvin in his earlier papers had done much to clear up ambiguities and to give definiteness to the terms used. Rowland, in America, carried out numerous experiments of great value, but it is to Ewing and Hopkinson that we owe our first real knowledge of the importance of the magnetisation curve, the meaning of the property known as hysteresis, which had a short time previously been investigated by Warbury, and the part this plays in the action of electrical machinery.

The experiments of Oersted and Ampère had taught us that an electric current circulating in a coil of wire produces a field of magnetic force linked with that coil, and, as Faraday proved, the inductive effects produced in any neighbouring circuit depend on the manner in which that circuit is also linked with the magnetic lines.

John Hopkinson in 1879 had shown how the properties of a dynamo could be deduced from its characteristic curve, the curve connecting the e.m.f. in the armature with the exciting current in the field coils; and in a joint paper with his brother Edward, read before the Royal Society in 1886, he described how the form of this curve could be obtained graphically for a dynamo of known design and dimensions from the ordinary laws of electro-magnetism and the known properties of iron which Ewing had shown how to determine. The theory of the dynamo was complete in its main outlines. Since then progress has been rapid. Theory has indicated the direction in which improvements were to be sought; the skill of the metallurgist, the engineer, and the designer has been called in to put those improvements into practice.

The result you know. Conceive the world without electric power—London without its tubes and railways, its electric light, telephones, telegraphs, and wireless services—and you will realise to some degree what is due to the labours of the physicists under whose skilled guidance all this system has grown up in the last twenty-five or thirty years out of the small seed sown by Faraday and his contemporaries.

It is not easy to obtain figures which give with accuracy the extent to which electrical power is used at present. In the Electrical Trades Directory for 1917 it is stated that more than 500,000,000*l.* has already been sunk in the industry, and there is every prospect of that sum being largely increased.

I have endeavoured to indicate in brief outline the process by which this stupendous result has been achieved. In the first place, we have the disinterested labours of the man of science impelled by the desire to know; then have followed the mathematician and the physicist, whose work has reduced the early observations of the experimenter to the rule of law, and when that law has been established it has become possible for the electrical engineer to grasp the problem and apply the teaching of the physicist to the needs of national life.

Illustrations of the process, proofs of the debt due to physics, could be taken from many other branches of science did time permit. The development of the steam-engine did not at first depend to any large extent on exact measurement and physical research. Progress was comparatively slow until Rankin and Kelvin developed the thermodynamics of steam—work continued in our own time by many well-known names, and turned to practical use of the highest importance by Parsons in the development of the turbine.

When the story of the past four eventful years can be fully written, the nation will realise to an extent it has never done before the importance of physics to our national life. What conclusions can we who do realise this draw from the facts I have imperfectly put forward? What lessons are there for the time that is to come, that reconstruction period, which, if rightly used, will mean so much to England? We must, to begin with, give the man of science a freer hand, a better chance to develop his discoveries; and, in the second, with this object we must educate the people to appreciate more fully the importance of science.

Men who can make great discoveries are few in number; increase the opportunities for their work when found, and encourage all that may help to develop them. Such a man may come from any rank of life. Mr. Seaton, in an interesting paper on the importance of research in marine engineering read recently before the Institution of Naval Architects, in directing attention to the fact that many inventions of importance to engineers have been made by men who were not engineers, writes thus:—"Bramah, one of the first to suggest the screw-propeller, was a blacksmith and locksmith; George Stephenson a fireman; "Screw-propeller" Smith, who patented a good workable propeller, was a farmer. . . . The inventor who exhibited an internal-combustion engine at Cambridge a hundred years ago was a parson; so also was Ramus, the inventor of the hydroplane ship. James Watt was an optical-instrument maker; the inventor of the chronometer was a gardener. "Increasing-pitch" Woodcroft was a librarian, Bessemer an artist, Armstrong a lawyer."

Though in these days of increasing specialisation the task of the amateur discoverer grows daily more severe, the importance, in the first place, of the educational ladder to give any boy of real talents his chance, and, in the second, of providing for the man who has proved he can advance knowledge and may make a real discovery, is paramount. No doubt the chances of success are small. Many will set foot on the ladder and climb to a greater or less height, but few will reach the top. No doubt also the selection of those who should be encouraged is difficult; examination success is by no means always the surest test, yet it is not easy to frame another. But then the discoveries of the men of science are rarely in a form to be assimilated directly by industry and to become available for the national advantage. It was a long step from Faraday's researches to the dynamo and motor of to-day; or from the Faraday dark space and Hittorf's experiments with cathode rays, and Röntgen's discovery of the X-rays, to the Coolidge tube and the X-ray outfit of the modern Army hospital; or, again, from Kelvin's paper on electrical oscillations in 1855, or Helmholtz's first suggestion of the same in 1847, to the modern developments of wireless telegraphy.

What action can we take to bridge the gulf, to render scientific discovery more readily available and spread more widely knowledge which may be of utmost service to the manufacturer? This I take to be the work of laboratories of industrial research, which I hope to see grow up in the various great centres of industry. In such a laboratory the staff are studying continuously to bring scientific knowledge as it advances to bear on industrial problems. They must be skilled experimenters with a sound knowledge of recent discoveries, a real zeal for the work they have undertaken, and a deep-seated belief in its importance to the nation. The laboratory must be equipped in a complete manner with plant and apparatus such as would be found in works, prepared to carry out the investigations necessary before a new process or idea, the outcome of some laboratory investigation, can be applied on a works scale.

For such work special laboratories and conditions are essential. The National Physical Laboratory should be one such; in time, a central institution for this task, correlating the work of the various local institutions, carrying out work which might be common to a number, and serving as a centre from which information is disseminated, and to which manufacturers will come for suggestions and guidance.

All this, however, will be of little avail unless the nation as a whole learns to appreciate its importance. What is to be done to evoke a more intelligent interest in physics among men at large; to induce our legislators to realise the necessity for large expenditure and generous support; to evoke a general faith in the efficacy of scientific method which would go so far to hearten and encourage the patient worker?

I am speaking mainly to teachers; let me, in conclusion, address a few words to you specially as such. If I have convinced you of the importance of my subject—many needed no convincing, I am sure—may I remind you that it is your great task to arouse this faith; to lead the rising generation to look on physical science, not as something outside and apart from their daily life, but as a source of strength and progress; to educate them so that they may realise more fully what they owe to the great men of the past who have sowed the seeds of England's power, and what they must do to preserve the heritage these men have handed down to them?

But how? The question is a difficult one to answer. There is a loud call for a more generous recognition of science in our schools, for curricula in which it has a larger share in the time-table, for more recognition for its teachers and more prizes and scholarships for its students. While this is most desirable, it is not enough; alone it will do little. Lord Bryce in a recent article writes:—"No man can be deemed educated who has not some knowledge of the relation of the sciences to one another and a just conception of the methods by which they respectively advance." Will the student gain this education merely by transferring him for so many hours a week from the literary side to the scientific side of the school? I fear not. Reform is needed in our methods of science teaching. I speak as one responsible in part for those methods with a consciousness of some fault. Forty years ago it was my privilege to organise, along with my colleague, Sir Napier Shaw, the teaching of practical physics at the Cavendish Laboratory. We were dealing, under difficulties, with young university students preparing to take a degree in science or medicine, men proposing to specialise. We had learnt the necessity for exact measurement in all research, the importance of a personal acquaintance with the methods by which our knowledge had been advanced; we were not then concerned with the general education of the vast mass of boys and girls throughout the country, and so we devised and extended the methods of practical physics. We made each student verify Ohm's law, measure the specific capacity for heat of copper, or the wave-length of sodium light; and that method, devised for a special purpose for which I still think it the most useful, lent itself to the examiner and the teacher as a method by which the mass of pupils could be instructed and examined. It has been extended and developed by many able and enthusiastic men; too often it is elaborated so far as to be little more than press the button and note what happens. You have then proved that the pressure of a gas at constant volume is proportional to its temperature.

In the case of the ordinary boy and girl the results have little more influence on their lives than the lists of the kings of Israel or the emperors of Rome, or the exceptions to some abstruse rule of grammar. They have been forced to learn by heart in order to train their memory. Sir Napier Shaw has recently written thus:—"When we come to consider such provision as there is for science in general education as represented by the opportunities actually offered to boys and girls at school, it is for me impossible to avoid the conclusion that what the exponents of physical science have evolved as the elements of scientific education is quite unworthy of the subjects we wish to expound."

If this be so, how then are we to remedy it? The question is one too difficult to answer at the end of a long lecture. I think a remedy is possible. The teacher ought, I feel sure, to be able to arouse an interest in the principles of his subject without a wearisome attention to details; to give to a class the general idea of what is involved in the ordinary laws of Nature; of what we mean by energy or momentum, the conservation of energy or the mechanical equivalent of heat; of the connection between electricity and magnetism and the historical development of the various laws about which he has been speaking—in fine, to give the pupil some knowledge of the relation of the sciences to one another and a just conception of the means by which they advance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A conference on women in industry will be held under the auspices of the Industrial Reconstruction Council on Tuesday, October 22, at 6 p.m., in the hall of the Institute of Journalists, 2 and 4 Tudor Street, E.C.4. The subject will be introduced by Miss Lilian Dawson, after which the discussion will be open. No tickets are necessary.

A course of three public lectures on "France's Share in the Progress of Science" will be delivered at University College on Tuesdays, October 22 and 29 and November 5, at 5 p.m., by M. Henri L. Joly, professeur de sciences physiques et naturelles au Lycée Français (Institut Français du Royaume Uni). The chair will be taken at the first lecture by Prof. J. Norman Collie. A leaflet containing a full syllabus of the lectures may be obtained by sending a stamped addressed envelope to the Publications Secretary, University College, London (Gower Street, W.C.1).

The Armstrong College (Newcastle-upon-Tyne) calendar will not be published for the current session, but the prospectus of day classes, a copy of which has reached us, contains the essential particulars respecting the courses of work in pure and applied science which have been arranged for the academic year 1918–19. Students of pure or technical science in the college may proceed to the degrees in science of the University of Durham, of which the college is a part, and, according to the number of years of study, may present themselves for graduation as bachelor, master, or doctor of science, or as doctor of philosophy. For the degrees of master and doctor great importance is attached to success in research. We have received also the current calendar of the Royal (Dick) Veterinary College, Edinburgh, which was founded in 1823 by the late Prof. Dick, and endowed by him, his sister, and Mr. A. I. MacCullum. The college prepares its students for the diploma of membership of the Royal College of Veterinary Surgeons and degrees in veterinary science in the University of Edinburgh, and also offers facilities for post-graduate work.

SOCIETIES AND ACADEMIES.

Melbourne.

Royal Society of Victoria, July 11.—Mr. J. A. Kershaw, president, in the chair.—C. **Fenner**: The physiography of the Werribee River.—Prof. T. H. **Laby** and E. O. **Hercus**: The thermo-conductivity of air.

Sydney.

Linnean Society of New South Wales, March 27.—Prof. H. G. Chapman, president, in the chair.—Dr. A. B. **Walkom**: The geology of the Lower Mesozoic rocks of Queensland, with special reference to their distribution and fossil flora, and their correlation with the Lower Mesozoic rocks of other parts of Australia. The Lower Mesozoic rocks of Queensland comprise three divisions—the Ipswich, Bundamba, and Walloon series. The Ipswich and Bundamba series are of comparatively limited distribution, and are confined to the south-eastern portion of the State. The Walloon series has a much greater extent; in addition to occurring in south-eastern Queensland, in association with the Ipswich and Bundamba series, it outcrops in a belt along the western slope of the Main Divide from the New South Wales border to Cape York, dipping westerly beneath the marine Cretaceous. It probably underlies the Cretaceous strata over the greater part of western Queensland. In eastern Queensland there are a number of small isolated occurrences of the Walloon series. The thicknesses of the three series are, approximately: Ipswich series, 2000–2500 ft.; Bundamba series, 3000–5000 ft.; and Walloon series, up to 10,000 ft. A comparison of the Queensland Lower Mesozoic strata with other occurrences in Australia of similar age seems to show (1) that the Narrabeen and Hawkesbury Sandstone stages in New South Wales are older than the Ipswich series; (2) that the Wianamatta stage of the Hawkesbury series in New South Wales, and also possibly part of the Lower Mesozoic strata of Tasmania, are of the same age as the Ipswich series; and (3) that the following series in the other States are of the same age as the Walloon series: The Artesian series, Clarence series, and Talbragar beds in New South Wales; the Jurassic strata of the South Gippsland, Cape Otway, and Wannon areas of Victoria; the Leigh's Creek beds in South Australia; part of the Lower Mesozoic strata of Tasmania, and the marine Jurassic series in Western Australia.—Dr. R. J. **Tillyard**: (1) Studies in Australian Neuroptera. No. 5: The structure of the cubitus in the wings of Myrmeleontidæ. An examination of the pupal tracheation of the fore-wing of *Xantholeon helmsi*, Tillyard, reveals the presence of the original archaic Cu_2 close to the base of the wing, where it fuses with 1A. The veins hitherto called Cu_1 and Cu_2 respectively are shown to be, in reality, Cu_{1a} and Cu_{1b}. As a result, the position of the tribe Creagrini within the subfamily Dendroleontinæ has to be revised, the genera included in it being shown to be much more highly specialised than has hitherto been thought possible. The phylogenetic stages by which the condition of Cu in the fore-wing of Myrmeleontidæ has been reached are shown to be still existent in some ancient types of Hemerobiidæ. (2) The affinities of two interesting fossil insects from the Upper Carboniferous of Commentry, France. The paper discusses the affinities of *Megagnatha odonatiformis*, Bolton, and *Sycopteron symmetrica*, Bolton, described from the types in the "Mark Stirrup" collection, Manchester Museum. The former is assigned by Bolton to the Perlaria, with possible relationship to the Sialidæ. These affinities are disproved, and the suggestion is made that the insect is, in reality, an ancient representative of the Embioptera. A detailed comparison is made with the recent genus Oligotoma. The Sycopteron is assigned by Bolton to the Mecoptera. This is shown to be extremely doubtful, and a much closer resemblance is proved between the fossil and the Psocopterous genus Amphientomum (Oligocene and recent).

April 24.—Prof. H. G. Chapman, president, in the chair.—Dr. H. L. **Kesteven**: The origin of yolk in the ova of an endoparasitic Copepod.—Dr. R. Greig **Smith**: Contributions to a knowledge of soil fertility. No. 16: The search for toxin producers. It has been shown that certain soil bacteria, moulds, and amœbæ, all reasonably supposed to be capable of furnishing substances of a toxic nature, were grown in various media and under varying conditions, and in all cases the signs of toxicity which became manifest could be attributed to an alteration in the reaction of the media. The test organism, *Bacterium prodigiosus*, grows best in a neutral medium, and an indicator is required which will indicate strict neutrality. The methyl-orange numbers are too high, and the phenolphthalein too low. Small divergences from the neutral point strongly affect the growth. The humus of leaf-mould contains two types of humic acid; one absorbs alkali from alkaline carbonates, and the other from alkaline carbonates and hydrates. These were present to the extent of one part of the former to three of the latter. Heating the humus increases the amount of acid, and the increase is largely soluble in water. The effect of reaction is quite of a different order from the evidence of toxic action obtained in former researches.—J. J. Fletcher and C. T. **Musson**: Certain shoot-bearing tumours of Eucalypts and Angophoras, and their modifying influence on the growth-habit of the plants.

BOOKS RECEIVED.

A Memoir on British Resources of Refractory Sands for Furnace and Foundry Purposes. Part i. By Prof. P. G. H. Boswell, with Chemical Analyses by Dr. H. F. Harwood and A. A. Eldridge. Pp. xii+246+plates xi. (London: Taylor and Francis.) 8s. 6d. net.

The Modern Geometry of the Triangle. By W. Gallatly. Second edition. Pp. vii+126. (London: F. Hodgson.) 2s. 6d. net.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iv., part 5. (Sydney: The Government of the State of New South Wales.) 2s. 6d.

Studies in Clocks and Time-keeping. No. 2. Tables of the Circular Equation. By Prof. R. A. Sampson. (Edinburgh: R. Grant and Son.) 2s. 10d.

A Monograph of the British Lichens: A Descriptive Catalogue of the Species in the Department of Botany, British Museum. By A. Lorrain Smith. Second edition. Pp. xxiv+520+71 plates. (London: British Museum (Natural History).) 30s.

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 17.

INSTITUTION OF GAS ENGINEERS, at 10.—Lt.-Col. Arthur Smithells and Prof. John W. Cobb: Preliminary Report of the Gas Investigation Committee.—B. R. Parkinson: Life of Gas Meters Research Committee Communications on "Unaccounted-for Gas."—J. G. Taplay: Corrosion of Dry Gas Meters.—Dr. J. W. Mellor: Report of Refractory Materials Committee.—Walter Emery and Dr. A. Scott: The Corrosive Action of Flue-dust on Fire Bricks.

FRIDAY, OCTOBER 18.

INSTITUTION OF GAS ENGINEERS, at 10.—Papers from list given above.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.

TUESDAY, OCTOBER 22.

ZOOLOGICAL SOCIETY, at 5.30.—Prof. H. M. Lefroy: Wheat Weevil in Australia.—Sir E. G. Loder, Bart.: Notes on the Beavers at Leonardslee, 1916-18.—G. A. Boulenger: The Madagascar Frogs of the Genus Mantidactylus, Blgr.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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NOTICE.

In consequence of the greatly increased cost of production it has been found necessary to raise the price of NATURE to 9d. The alteration takes effect from to-day, and the Subscription rates are now as follow:—

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THURSDAY, OCTOBER 24, 1918.

WASTE AND WEALTH.

Wealth from Waste: Elimination of Waste. A World Problem. By Prof. H. J. Spooner. With a Foreword by the Rt. Hon. Lord Leverhulme. Pp. xvi+316. (London: G. Routledge and Sons, Ltd., 1918.) Price 7s. 6d. net.

In spite of its limitations, and notwithstanding certain faults of style and taste, this book is calculated to serve a useful purpose, and it makes its appearance at an opportune time. Thrift is not a national characteristic of the southern half of Great Britain, whatever it may be of the other half.

The author quotes a remark of Archdeacon Potter made at an economy meeting at Mitford in the early part of 1916 as evidence of a fact which, unfortunately, cannot be controverted: "I have travelled all over the world, and I have never known any nation or people so wilfully wasteful as the people of our own country. In no other country do people so absolutely fling away God's goods as they do in England." In proof of this statement Prof. Spooner, in the course of some 300 pages, piles Ossa on Pelion. His book is an attempt to show that in practically every department of our national life and activity "wicked waste is occurring everywhere, far and wide: waste of money, waste of food, waste of materials, labour, fuel, energy, and time, waste of human strength and thought, waste of health, and waste of life itself." This is a sweeping generalisation, which, by its over-emphasis, is calculated to prejudice the main conclusion the author seeks to establish, which is that this waste is avoidable, and ought, therefore, to be prevented. If the argument were stated more temperately it would carry greater conviction. Some waste, as the whole scheme of Nature testifies, *pace* Lord Leverhulme, is inevitable. The author implicitly admits this when he allows that there are justifiable wastes and dangerous economies. What he terms "absolute waste," due to corrosion and wear, is, in many cases, unavoidable. Exaggeration never strengthens a case in the eyes of a well-informed reader, and it is the well-informed reader that counts in the long run. Still, when every allowance is made for the author's somewhat too zealous efforts to prove his main contention, enough remains to show that much may be done in the direction of greater economy and in the reduction of waste—a conclusion which nobody will gainsay.

In a series of chapters the author seeks to enforce the lessons of the war. He makes an urgent appeal for better municipal organisation; he shows how time is wasted in factories and in commercial matters; how the public time is wasted in Parliament and in judicial procedure; he directs attention to the waste due to traditional and conservative methods in works management, and to the mischievous policy of restricting output; he shows how much waste is due to human fatigue; what wastage there is of life, limb, and health, and what is its economic effect; the waste due to infant mortality, child-labour exploitation, and preventable accidents; the waste of food arising from bad household management and lack of knowledge; waste due to adulteration; the waste of coal owing to our partial and imperfect attempts to treat the coal question scientifically; how indefensible is the sliding-scale contract system, and what is its effect on "public prices." He treats of fuel economies in the house, the smoke nuisance, electrical supply, and the creation of central power stations. He deals with what he styles the coming agricultural revolution, the home-grown food question, the technical education of the farmer, labour-saving machinery for the increase of tillage, demobilisation and farm work, the utilisation of waste land, intensive culture, reclamation schemes, waste due to the neglect of afforestation, the timber problem, etc.

In a special section of the work Prof. Spooner shows what has been done in the past to utilise waste substances, and how the waste of perishable things has been prevented. This portion, which he entitles "The Romance of Waste," is put together *pour encourager les autres*, and to prove that there is the potentiality of wealth in waste, as illustrated by the time-honoured examples of alpaca, shoddy, mungo, imitation sealskin, poplin, paraffin oil, linoleum, glycerin, etc. Another section is devoted to household wastes and economies, whilst a third deals with trade and industrial wastes, daylight saving, the waste due to derelict waterways, etc.

It will be seen, therefore, that the book covers a very large amount of ground. The author is certainly to be congratulated on the industry he has employed in its compilation and for the amount of information he has succeeded in compressing into a limited space. The work is simply and unaffectedly written, and appeals rather to the man in the street than to the expert. The author's knowledge of scientific facts is occasionally at fault, and his narratives of certain historical matters are now and again open to correction. "E. C. Stafford" (p. 267) should read "E. C. C. Stanford," and "carbon disulphite" (p. 87) should be changed to "carbon disulphide." The statement concerning dust in the vicinity of a Bunsen flame (p. 61) would seem to imply that the dust is a product of the flame, and the account of reclaimed rubber reads as if the process were something in the nature of adulteration, which is surely contrary to the lesson which it is the whole object of the book to enforce. Such a statement as "leather is frequently adulterated with glucose, soluble salts, and barytes, whilst treated tripe and compressed paper are known to be used as poor and fraudulent substitutes for leather" (p. 116), is calculated to convey an entirely false impression, and it is a gross exaggeration to say that "a great part of the wines of France and Germany has ceased to be the juice of the grape" (p. 112).

Lord Leverhulme, with a sense of humour, which is in strong contrast with the author's *ex parte* emphasis, makes the point that his foreword is "an apt illustration of that kind of 'waste' which is the saddest type of all wastes—a wasted opportunity." Here we join issue with his lordship. So far from neglecting it, he seizes the opportunity to state that in his opinion "the greatest wasters are those who concentrate their whole time on mere efforts for immediate and direct money-making." Such a preachment from so great a captain of industry serves to point a moral for which we share Prof. Spooner's gratitude.

MENTAL DISORDERS AND THEIR TREATMENT.

(1) *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; London: Longmans, Green, and Co., 1918.) Price 1*s.* net.

(2) *The Re-education of the Adult:* I. *The Neurasthenic in War and Peace.* By Capt. A. J. Brock. (London: Headley Bros.) 6*d.*

(1) IN this lecture Dr. Hart discusses modern conceptions of the nature and treatment of mental and nervous disorders. He points out that, though the "physiological conception"—the belief that mental and nervous disorders are due to deranged bodily processes, and in particular to diseases of the brain—still holds its place, its sway is no longer undisputed, for there has now arisen the "psychological conception," which holds that some at least of these phenomena are due to mental causes, capable of determination by psychological investigation, and of removal by psychological methods of treatment. The conspicuous success of this latter treatment has been amply demonstrated in our military hospitals for "shell shock" and similar disorders. Dr. Hart insists upon the present imperative necessity of provision for civilian patients, both men and women, in those incipient phases of mental and nervous disorder when treatment promises the best results, and urges the desirability of institutions in which physiologist, chemist, and psychologist can attack, together and from every side, the many problems that await solution. In emphasising the necessity for the close association of treatment with organised investigation and with teaching, he points out that these three functions have their natural home in the universities and medical schools, and it is from them that we shall confidently expect the developments that are so urgently needed.

(2) This essay forms part of No. 4 of the second series of "Papers for the Present." Describing the "shell shock" hospital as "a microcosm of the modern world, showing the salient features of our society (and especially its weaknesses) intensified, and on a narrower stage," the author describes some of the re-educative methods which, having proved successful, may be commended to the attention of the educationist and those devoting themselves to the general problems of social reconstruction. Underlying all the symptoms of neurasthenia is found the element of separatism or dissociation—a significant fact for social psychology. Some of the current psychological methods of dealing with neurasthenia are placed by the writer into three groups, which, he says, are steps in a progressive series: (1) Psychoanalysis; (2) therapeutic conversations; (3) "ergotherapy." In methods belonging to the first group the mental condition is analysed, in the second the patient is "encouraged to look sensibly and squarely at things," while in the last he is "prompted to follow up his thoughts by action—by real functioning in relation to his environment."

INORGANIC CHEMISTRY FOR STUDENTS.

(1) *Introduction to Inorganic Chemistry.* By Prof. A. Smith. Third edition. Pp. xiv+925. (London: G. Bell and Sons, Ltd., 1918.) Price 8*s.* 6*d.* net.

(2) *Experimental Inorganic Chemistry.* By Prof. A. Smith. Sixth edition. Pp. vii+171. (London: G. Bell and Sons, Ltd., 1918.) Price 3*s.* 6*d.* net.

(3) *A Laboratory Outline of College Chemistry.* By Prof. A. Smith. Pp. v+206. (London: G. Bell and Sons, Ltd., 1918.) Price 3*s.* net.

(1) AMONG the text-books of inorganic chemistry of the newer type, in which the attempt is made to present the descriptive material so far as possible in connection with underlying theoretical principles, Prof. Alexander Smith's "Introduction to Inorganic Chemistry" is one the merits of which have gained wide recognition, and that a third edition of this work has become necessary will occasion no surprise.

A comparison of the present with the previous edition shows that some alterations have been made in the arrangement of the subject-matter and that a considerable amount of additional information has been inserted, corresponding with the advances of the past decade where these have come within the scope of an introductory text-book. Thus the account of the radio-active elements has been greatly extended, and there are new sections on colloidal solutions, the atomic numbers, and other subjects of a theoretical character. A number of paragraphs have also been inserted on some of the more recent technical applications of chemistry, such as the manufacture of nitric acid from the atmosphere, synthetical ammonia, the oxyacetylene flame, the application of tungsten, the use of permutite for water-softening, and so forth. By these additions the usefulness of the book is fully maintained, and it continues to give a scientific and attractive outline of the present state of chemical knowledge of a standard suitable for the highest forms of schools or for university students who are beginning the study of chemistry. There is, however, one passage in an introductory discussion of the transformations of energy which cannot be allowed to pass unnoticed. It is stated (p. 32): "So, with a conductor like the filament in the lamp, unless it offers resistance to the current *and destroys a sufficient amount of electricity*" (the italics are ours) "it gives out neither light nor heat." It is to be hoped that this will be amended in a later edition.

(2) "Experimental Inorganic Chemistry" is a laboratory companion to the text-book discussed above. It contains directions for carrying out a large number of experiments of various types, including illustrations of chemical laws, the preparation of substances and examination of their properties, some qualitative analyses, and simple experiments in physical chemistry. The instructions are very clear and precise and seem well designed to lead students to work thoughtfully. In a few cases, however, the methods given for carrying out the experiments appear a little crude for the class of students that would be capable of using the companion text-book intelligently.

(3) "Laboratory Outline of College Chemistry" is almost identical, word for word, with the last-mentioned work (2). There are, however, differences of arrangement, and in the order in which subjects are treated, which render it more suitable for use with the author's "General Chemistry for Colleges." It contains a short chapter, which is not included in "Experimental Inorganic Chemistry," on Bunsen's film and match tests. This is a welcome feature, for it is to be wished that these tests, on account of their elegance and of the training in manipulation which they afford, were taught more frequently than is at present the case.

W. H. M.

OUR BOOKSHELF.

Homeland: A Year of Country Days. By Percy W. D. Izzard. With illustrations by Florence L. Izzard and W. Gordon Mein. Pp. 383. (London: John Richmond, n.d.) Price 7*s*. 6*d*. net.

THIS book consists of a series of sketches—mostly impressionist—of the march of the seasons in the Eastern Counties of England. There is one for each day in the year, and the author shows his good sense by beginning with March 21 and ending with March 20. "So we set out in the thrill of the year's morning songs and climb with the sun to the high noon of summer; then go down the hill of autumn and traverse the valley of winter, and so arrive again before the portals of spring. Thus hope is with us first and last." And delight as well, we may say, for Mr. Izzard's pictures—many of them just vignettes—have a delicate touch, awakening old joys. On reading them we feel that the author is one who would sincerely say with Stevenson:—

> To make this earth our hermitage,
> A cheerful and a changeful page,
> God's bright and intricate device
> Of days and seasons doth suffice.

Let us mention a few titles: "Laggard Spring," "Snow and Kingfishers," "The Elms in Bloom," "Wine of Spring," "Bluebells," "The Top of the Morning," "The Honey Way," "Bees in the Broom," "A Yellow Wagtail," "A Summer Shower," "Scented Night," "Grass of the Dunes," "Ageing Leaves," "Spider-Craft," "Rain on the Wheat," "Autumn Colour," "A Pimpernel Morning," "Winter Sleeps." These are not informative essays, be it understood, but dainty bits of impressionism, pleasant to read for a few minutes in the morning, and rejoicing the heart. The book has some beautiful black-and-white illustrations by Florence L. Izzard and W. Gordon Mein, and it is very pleasantly printed with a page for each day. We recommend it heartily to those who have "a love of the country."

The Portal of Evolution: Being a Glance through the Open Portal of Evolution at Some of the Mysteries of Nature. By a Fellow of the Geological and Zoological Societies. Pp. 295+ii. (London: Heath, Cranton, Ltd., 1918.) Price 16*s*. net.

THE author of this book begins chap. i. with the words: "My aim in writing this treatise has been to avoid making it in any way a scientific work." We are bound to say that he has succeeded. For what we opened with the eager hope of getting some fresh light on the factual problems of evolution turns out to be a sheer eccentricity. It is a serious but futile elaboration of extravagant hypotheses about the intermarrying of the diverse attributes of the Trinity. It is a preposterous attempt to illumine facts by fictions and to talk two languages at once. Of the author's scientific incompetence a glimpse is given in a statement in the first chapter: "Embryology has established beyond dispute that in the early stages of our conception within our mother's womb we again assume the types of worms, fishes, animals, and in some cases of plants that did their part in evolving our present existence." But a glimpse of something worse is given in the fundamental statement: "The intermarrying of the attributes of God's personalities has indeed placed in my hands a key that would, in time, with thought and study, enable mankind to unlock the door and enter the portal of Evolution, and ultimately to be able to understand divine revelations. . . ." We do not wish to be too hard upon a treatise so obviously serious and well-intentioned, especially as we are assured that "it is only during the last one hundred years that the property of understanding has dawned upon man," but we cannot help feeling that there has been a sad waste of paper here.

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 Organisation of Scientific Workers.

THE Whitley Report on Industrial Councils raises several questions of peculiar interest to scientific workers. It is proposed that a predominant part of the control of any industry shall be based on the recommendations of industrial councils, bodies composed of representatives of the employers' associations and trade unions concerned. Among the subjects with which these bodies will deal are conditions of employment, technical education, and industrial research (para. 16), which are of special interest to the scientific staff. Owing, however, to the lack of organisation among scientific men, there is no method of obtaining their representation on these councils, and if this is not done these matters will be decided by the other bodies involved, without reference to those whom they particularly concern. The need for such organisation is urgent, for it is made clear (Appendix, question 3) that only trade unions and employers' associations are to be represented, and that any body formed later than the council can be admitted only with the approval of its predecessors. The interests of the scientific workers in any industry, therefore, demand that they should form themselves into trade unions.

This statement is not so alarming as it at first sight appears, for legally a trade union is merely any body among the objects of which is the regulation of conditions of employment; so that any organisation formed to represent its members on the councils would be automatically a trade union. Employers' associations are technically trade unions. The other methods of obtaining its aims are determined by itself, and, naturally, no course of action repugnant to the majority of scientific men could be taken by a body that they themselves govern.

For very similar reasons it seems desirable that workers in pure science should form a trade union among themselves. The Department of Scientific and Industrial Research is likely to extend its influence very much in the near future, and pure research will be aided by the establishment of many fellowships and studentships, the workers appointed being in the position of employees of the Department. Here, again, there is no machinery for ascertaining the opinion of the employee on matters that concern him; and it seems at least as desirable to consult the opinions of research workers in their own affairs as those of ordinary workmen, as will be done when the Whitley report is carried out. That the success of the scheme promoted by the Department depends largely on the satisfaction of the employees with their position is admitted repeatedly in its latest report (pp. 21, 43), and a means of expressing their views is needed; this can be afforded only by a general organisation of research workers on a democratic basis and working in close touch with the Department. At the same time such a body must deal with conditions of research in general, and would come within the legal definition of a trade union.

The only body at present in process of formation that aims at attaining these objects is the National Union of Scientific Workers. Its inclusion of both pure and applied science within its scope corresponds with the policy of the Department of Scientific and Industrial Research, and seems highly desirable from the point of view of the co-ordination of science and industry.

C. SHEARER.
FRANKLIN KIDD.
HAROLD JEFFREYS.

SCIENCE AND PARLIAMENTARY REPRESENTATION.

THE discussion which has followed the meeting of the medical profession held at Steinway Hall on October 1, "having for its object the securing of a more adequate representation of the medical profession in Parliament," has served to show that its restricted objective is hazardous and inadequate. But at least it made prominent one of the essential conditions of successful emergence from the earthquake of the world war, viz. the instant and judicious application of competent knowledge to every branch of national and provincial administration. Those who think this must accompany schemes of national development will thank the conveners of the recent meeting, recognise the value of the discussion it induced, and proceed to ponder how fitting use may be made of the opportunity described by Dr. Addison, the Minister of Reconstruction. It has been made clear that, in the opinion of many entrusted with the executive power of the State, the time has come when those who possess trained knowledge have special opportunities to which as patriots they ought to respond. These opportunities have not come to medicine alone; they have come to every branch of science and technology. It may be well, therefore, to review very briefly the circumstances in which the contributions of trained knowledge to national development may now be made continuously effective. Most of the factors of use or abuse are common to the professions, and if medicine is chiefly referred to in illustrating, it will be as a tribute to its splendid services to-day and to its Steinway Hall initiative.

Nothing can be satisfactorily attempted in Parliament or politics generally unless goals are so clearly stated that willing players of the game can see them. At the recent meeting, where one goal was assumed to be sought, two were set. There was, first, the goal of the "representation of the medical profession" in Parliament, to quote some of the speakers, the *Times* leading article, and some later letter-writers. There was, secondly, the goal of making possible to the community and Parliament "the considered experience and help of medical men as representative of the public interest and aiders of their constituencies" (Dr. Addison). Now the two may stand in the same field, but they are different. They may not be wholly incompatible, but they are diverse; twins, perhaps, but of very different temperaments. Despite some obscurities, Dr. Addison's address suggests that he prefers the second. In letters to the medical and general Press some powerful critics have made it clear that they agree with him. So do we. It is the more catholic, practical, and promising; and for this reason: whatever the professions apart from politics surmise, the political instincts of a politically matured people are not likely to err. It may be hoped, therefore, that these will promote, not the representation of particular interests in Parliament, but the selection of leading men from all spheres of intellectual and industrial activity to assist in the control of national affairs.

That knowledgeable candidates with expert capacity must first be citizens of a free country before they are expert consultant members of its Parliament is essential to the future of knowledge as a political instrument and to the success of those who thus use it. This is especially true to-day from causes that are not yet sufficiently realised. In many departments of commercial, professional, and class effort class interests have had to be emphasised beyond prudence to get any type of organisation accepted by disunited individual units. Much organisation of a roughly hewn type has been accepted, therefore, and in industry, as in war, generalship has had to be improvised, with like disastrous results sometimes. The price which has inevitably to be paid for inefficient organisation, for organisation, that is, which permits the machine to run the man, is troubling the counsels of parties and groups, and threatening grave evil to the country—in its executive action itself a bad culprit.

It is to inadequate knowledge at the top of professional and class organisations that most of the prevalent functional disorders are due. The tool is not just now esteemed. It is highly probable that the good sense of the community, dimly conscious of class dangers, will assert itself on suitable occasions against class demands and all extensions of class representation. Moreover, the future is not with this method, as trade-unions and capitalistic organisations are finding out. That way lies death. A virile race uses organisations, but is not mastered by them or dictated to by them. Surely it will be most unfortunate, futile as well as unfortunate, for the as yet unmobilised scouts of knowledge to handicap themselves by following an example seen to be reactionary and dangerous. Theirs the better prospect of appealing directly to the happier instincts of a free and growing race, of demonstrating that in seeking to serve their country in the hour of its greatest need they wish to place its interests before any other interest, personal, professional, or, for that matter, partisan. They stand as citizens to serve as citizens: that is the path of honour and of leadership. It is the path also of success.

The work to be done has to be done in Parliament, we are told, and through Parliament. This implies ability to understand and to participate in the general work of Parliament, whence all their opportunities will arise. Important as is the physician's experience and mental equipment in diagnosis, when he has his patient before him the prime factors are the patient himself and his potential response to any treatment. So, if the professional man, the expert, is to hold his own in a Chamber sufficiently filled with the representatives of commerce and labour, however true to his own professional responsibilities he may be, he must first look at the work to be done from the point of view of the national interest so far as his special gift can further it, in order that the object of the Bill which takes time may be worthy of Time. He must be able to establish and to maintain touch with his parliamentary colleagues, to adjust that which he knows to the medium in which it has to be applied—no light task—and thus to make effective the special contribution he has to bring. His most valuable aid may sometimes consist in preventing gross mistakes being perpetrated in ignorance, but to pull up any machine in full motion demands exact knowledge of its mechanism. No Member of Parliament who knows his own special business, his business as a legislator, and the routine of the House, would fail to get a hearing; what a power he might become! He cannot understand his business as a legislator unless he makes that his first and chief object.

If this is true of the House of Commons, how much more true is it in the constituencies. The closest contact of knowledgeable candidates with the electorate is necessary to-day if electors are to learn their duty, choose and support educated and efficient administrators, and discountenance inefficient administrators. Can the electorate be adequately served if selected constituencies are to be offered eminent experts in science and technology with specialist limitations, whose presence in Parliament is desired that they may attend the consulting-rooms of State Departments, sit on Special Committees, or voice, occasionally, some sectional interest? Surely these services can be commanded at any time without imposing a preliminary qualification which would in itself then be but a pretence. And what of the influence of such practice on the men themselves and on the repute of the intellectual ministry for which they stand? It may well be that some of the most useful men of one category would also be available in another; as was said, the two goals are not wholly incompatible. The consultant might be the man who, before his constituents, could interest them in knowledge, reveal the folly of some section in a contested Bill, or, later, show how a clause, vital to the success of a new Act, might at once be made locally operative. If so, both needs would be met in the same man. But even then it is on the citizen plane that true representation has to be sought. Both in the Commons and in the constituencies this is the type of service which is alive: it grows.

Knowledge is not static; it is dynamic. It perfects itself in practice amid ever-changing atmospheres, and owes most of its efficacy at any time to perceptions and extensions gained in performance of function. In free nations the demands of each parliamentary session will give professional counsel its chance and chiefly determine its usefulness. The limitations of Parliament as a patient are gross and grave. But it is the only patient here on view. Knowledge has its work therewith, and knowledge must do it: it can only be done on the basis of approved citizenship. The nation should get nothing meaner.

To sum up. The coming General Election will make a special demand on the men best equipped to serve the country, and in many respects that demand has never been easier to meet. During no previous epoch has the country depended more for its preservation on competent and ascertained knowledge, and never have we had with us a larger number of available men skilled in some branch of knowledge and already familiar with the administrative and functional routine through which that can best be applied to national work. Men of affairs, themselves prominent in the ranks of men of science, are neither few in number nor unknown to constituencies. Something has been said in medicine about the exact constitution and responsibilities of the committee which should select suitable candidates for whom seats could be found. It does not matter very much what method of selection is taken so that the right goal is clearly set up, and there are those ready to be true to the test of the time. A very small sum of money—small as sums go to-day—in the hands of a few administrators acquainted with the problems and with the *personnel* of the scientific world would permit them at once to consult the party Whips and arrange for the candidature of an experimental group such as competent State chiefs would gladly welcome to the House and constituencies live to be thankful they ever sent there.

J. J. ROBINSON.

EPIDEMIC INFLUENZA.

THE name "influenza" is of Italian origin, and is derived from the Latin *influxio*, which signifies a humour or catarrh. Creighton[1] gives the following account of its introduction into the English language:—

"It was in 1743 that the Italian name 'influenza' first came to England, the rumour of a great epidemic, so called, at Rome and elsewhere in Italy having reached London a month or two before the disease itself. The epidemic of 1743 was soon over, and the Italian name forgotten, so that when the same malady became common in 1762 someone with a good memory or a turn for history remarked that it resembled 'the disease called influenza' nearly twenty years before. After the epidemic of 1782 the Italian name came into more general use, and from the beginning of the present century [*i.e.* 1801] it became at once popular and vague. The great epidemics of it in 1833 and 1847 fixed its associations so closely with catarrh that an 'influenza cold' became an admitted synonym for coryza or any common cold attended with sharp fever." The last-named usage has lingered in common parlance to the present day, and such "running" colds are frequently contagious. The series of epidemics from 1889 to 1893 effectually dispelled the idea of the necessary association of epidemic influenza with catarrh.

It has also been customary since 1893 to term "influenza" any brief febrile affection associated with more or less headache and muscular pain. The nature of such attacks is little known, but the majority are certainly not true influenza. Epidemic influenza is a malady which has probably existed from the earliest times. Creighton traces allusions to it in the medieval Latin writers, and in the sixteenth and seventeenth centuries strange epidemics are recorded from time to time under such names as "new disease," "hot ague," "sweating sickness," and others which seem undoubtedly to have been manifestations of it, and the disease has recurred again and again with an interval of a few years. In the nineteenth century, after an outbreak in 1855, more than a generation passed with little or no mention of epidemic influenza in this country, when in the early weeks of the winter of 1889 reports began to be published on the reappearance of influenza in Moscow, Petrograd, Berlin, and other foreign capitals. This epidemic wave, like many that preceded it, had an obvious course from Asiatic and European Russia towards Western Europe, and eventually reached London, and in January, 1890, had a decided effect upon the bills of mortality of the city. It spread all over England, Scotland, and Ireland, but by the spring of that year had almost disappeared.

The features of the disease at this time were a sharp and sudden attack of fever, accompanied with headache, pain at the back of the eyes, pains in the limbs, and severe back-ache, with prostration and a general feeling of misery. Catarrhal symptoms were by no means prominent, but in the elderly the disease was frequently complicated by bronchitis, pneumonia, and heart failure, and convalescence was often prolonged. The pronounced back-ache and absence of catarrh at first suggested that the malady might be dengue fever, but it was soon recognised that the epidemic was one of genuine influenza. The disease recurred in 1891, 1891–92, and 1893–94, and then waned and almost disappeared. The worst period was in January, 1891; in the week ending January 23 the death-rate in London rose to 46 per 1000 living (a month previously it had been 21·9), and 506 deaths from influenza were registered, as well as a very high mortality from bronchitis and pneumonia.

After a period of quiescence lasting for three-and-twenty years, influenza in epidemic form once more made its appearance towards the middle of the present year. In May and June it ravaged Madrid and other parts of Spain, afterwards attacking the British and German forces on the Western front, and travelling to this country, Holland, and Scandinavia. London experienced a sharp attack in July, and some 1600 deaths are attributed to it. On the whole, however, this outbreak was a mild one, except among the debilitated and the aged. The usual course pursued by the disease was a sudden onset of sharp fever lasting about three days, with headache and muscular pain, but little catarrh, followed by rapid convalescence. By the end of August the epidemic was practically at an end. During the present month another outbreak has occurred and is in progress, and this time the disease is assuming a more serious character, and many deaths from pneumonia and bronchitis complicating it have been reported, particularly

[1] "History of Epidemics in Britain," vol. ii., p. 304.

among young and presumably strong and healthy adults. South Africa and Tangier are also experiencing severe epidemics.

While in previous epidemics the general progress of influenza has been westwards from Asiatic and European Russia, the epidemic this year was first reported in Spain and travelled northward. It is to be noted, however, that the war has fundamentally changed the general direction of European traffic—that from East to West being suspended, while the North and South traffic has been greatly augmented. It has to be remembered, too, that Chinese and other Eastern coolies have furnished Labour battalions behind the lines on the Western front, and it may be quite likely, therefore, that the disease has been imported from the East in this manner.

With regard to the nature of epidemic influenza, it is undoubtedly a fever of a highly infectious or contagious character, and, therefore, caused by some micro-organism. In the epidemic of the 'nineties Pfeiffer discovered a minute bacillus, difficult to grow except on certain specially prepared culture media, and even then yielding only very delicate growths, and unstained by the Gram method of staining. This is the influenza bacillus which has ever since been regarded as the causative microbe of epidemic influenza. In the epidemic of this year, however, Spanish, British, and German investigators have failed to find the influenza bacillus except in quite a minority of cases. The principal bacteriological findings reported are microbes belonging to the coccus class, either Gram-negative or Gram-positive cocci, and in some of the fatal cases streptococci have been present in the blood.

The difference in the bacteriological findings between the 'ninety and the present epidemics suggests that epidemic influenza, so-called, is not a single disease. We have a parallel to this in the case of typhoid and paratyphoid fevers, which in symptoms closely resemble each other, but which are due to distinct microbial agents. There are also certain differences in the symptoms present in different influenza epidemics which point to the same conclusion.

The principal factor influencing the spread of influenza seems to be close aggregation of individuals. It is the crowded office, workshop, barrack, or camp that suffers most from the ravages of influenza. Dilution with plenty of air mitigates the infectious properties, and free ventilation is therefore important. In the July outbreak favourable reports were given of the value of systematic spraying of the air of offices and workshops with an atomiser spray, using some volatile disinfectant, such as bacterol, in largely preventing the spread of infection. Fatigue and debility are always conducing factors to infection, and the young and the old are generally more prone to contract the disease. Whether any drug has really any power to prevent infection is questionable, but in the 'ninety epidemics there was a general impression that systematic daily doses of quinine were of some use.

R. T. Hewlett.

THE SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY.

The Salters' Company has during many years given evidence of its interest in the promotion of scientific education and research by the provision of fellowships tenable by post-graduate workers. It has now taken a further very important step in announcing a scheme for the establishment of an institute to be called "The Salters' Institute of Industrial Chemistry." The offices of the institute will be for the present at the Salters' Hall, and the scheme will be administered by a director, who will be selected on the ground of qualifications based on a distinguished academic career in chemistry coupled with extensive technical experience. An Advisory Board composed of representatives of the Salters' Company, the universities, and the Association of British Chemical Manufacturers is also under consideration.

The Company proposes to establish two types of fellowship, for which post-graduate students of British nationality will be eligible whether graduates of a British university or of a university in the United States or elsewhere. There are to be (1) fellowships to enable post-graduate students to continue their studies at an approved university or other institution under the general supervision of the director of the institute, and (2) industrial fellowships to enable suitably equipped chemists to carry on research for any manufacturer under an agreement entered into jointly by the institute, the manufacturer, and the fellow.

It will be observed that the Company does not at present contemplate the erection of any building or the equipment of any laboratory. Its aim is, therefore, somewhat different from that of the founders of such establishments as the Davy-Faraday Laboratory attached to the Royal Institution in London, or the Kaiser Wilhelm Institute opened in 1912 near Berlin. The intention is to add to the number of first-rate chemical technologists available for the service of industry in this country, a class of men which at present scarcely exists and is sorely needed. It is hoped to offer such attractions to some of the best students that on completing their university course they will seek to apply their knowledge to manufacture and industry generally, and that employers will recognise promptly the necessity for such assistance so that openings for such men with suitable remuneration will be provided concurrently with the supply. Hitherto almost the only career available for the honours graduate in chemistry has been in connection with the teaching profession. Probably in future such men will be divided into two classes according to their personal predilections, some going to the works, while others will prefer teaching. In both directions the opportunities provided have been insufficient in number and inadequate in remuneration, so that many cases have occurred in which a man with distinct scientific gifts has been forced by circumstances to seek employment in other directions, and science has been consequently the poorer.

The fundamental idea which has inspired the Salters' Company may be illustrated by one or two examples. Suppose a man to have taken his degree with distinction in chemistry, and in physiology as a second subject. Elected to a Salters' fellowship, he may undertake a research on some subject of a biochemical nature. This may be carried on at his own university or at any other possessing a special school for this class of work in England or some other country. In due time arrangements may be made by the director for the fellow to take a course of chemical engineering, perhaps in America, and afterwards to obtain technical and industrial experience. In a very short time a man so trained and experienced will be in a position to demand, and will certainly be worth, a very high salary. It would be easy to provide a similar course with the necessary modifications adapted to the case of a man whose original bent is in the direction of physical chemistry or pure organic or metallurgical chemistry. The printed scheme issued by the Salters' Company gives no information as to the pecuniary value of the proposed fellowships. In estimating the annual amount which should be assigned to each fellowship, it must be remembered that the holder, while required to live simply and carefully, must be free from difficulties about books, travelling expenses, and laboratory outlay. Probably 300*l*. a year under present conditions and for some time to come will not be found too much, though perhaps expenses will depend to some extent on whether the student remains at home or is required to reside at a foreign university or centre. When operations are to commence at the institute will depend on the discovery of the right man for the office of director, and doubtless he will have a good deal to say about working details.

The two classes of fellowship referred to in the scheme have been in principle anticipated. For the former, which provides for post-graduate study without at first direct reference to technical applications, the Ramsay Memorial, which has been before the public for the greater part of the last two years, has adopted essentially the same plan, and is only waiting for funds to carry it into effect.

With regard to the institution of industrial fellowships, nothing of the kind has yet been attempted in this country. But the Kennedy Duncan scheme in connection with the Universities of Kansas and Pittsburgh has been in operation for some few years, and is reported to have been satisfactory and successful. Mention of these facts, however, is not intended to disparage in any way the wise forethought and liberal intentions of the Salters' Company, which, by the action now contemplated, is rendering a very important service to national interests, both by the example thus set and by the generous application of its funds.

One other point may here be mentioned. The scheme under consideration seems to avoid the difficulty which has always been associated with other schemes for the encouragement of post-graduate work—namely, that the career of the student after the first few years was indeterminate, and often ended in disappointment. The scheme, once talked of, for providing valuable fellowships with the object of tempting a few specially endowed researchers to devote the rest of their lives to research seems to have been lost sight of, or, after consideration, to have been given up.

It is, however, to be hoped that nothing in the plans proposed for associating science with industry will result in discouragement to scientific genius. Researches undertaken with specific objects, especially with a view to improvements in manufacturing processes or to the invention of new ones, and in the investigation of properties of materials and products, will probably not lead to the discovery of new fundamental principles. In the past these have almost always been the fruit of labours undertaken under the stimulus of that kind of curiosity concerning Nature, her laws, purposes, and operations, which is sufficient to satisfy the ambition of a Davy or a Faraday. Whatever Ramsay might have done had he devoted his working life to researches designed to assist industry, the results of his studies concerning the source and properties of the inert gases, themselves of no use in human affairs, are of greater permanent interest and importance by reason of the new light thrown on the nature of the elements and the constitution of matter. After all, a knowledge of the materials and powers in which life is immersed, and of which it is a part, is in the long run more useful than the applications which may be made to the purposes of mankind. The student of Nature is concerned only about the means of carrying on his work without anxiety as to the future of himself or his family. His discoveries cannot immediately become the subjects of sale or pecuniary reward, and as a rule he does not look for anything of the sort. It will, however, not be forgotten that for the few there are the Nobel prizes.

THE RECONSTRUCTION OF THE FISHING INDUSTRY.

IT is no secret that a most vigorous propaganda for the reconstruction of the entire fabric of fishery control is now being carried on by those engaged in the industry, and that this movement gathers force as the end of the war appears to come nearer. The English propaganda takes the form of proposals for the unification of fishery control by the creation of a Ministry having all the powers now exercised by branches of several Public Departments and by the local Fishery Committees. Its suggestions relate mainly to administrative and regulative reforms, to problems of marketing, transport, distribution, exploitation, and technical education. The Scottish proposals, which have just become public,[1] devote but slight attention to administrative changes, but

[1] Memorandum on the Reconstruction of the Fishing Industry after the War. Prepared by the Scottish Steam Drifters' Association, Aberdeen, at the *Daily Journal* Office, September, 1918.

emphasise in the strongest manner the necessity for the organisation on a large scale of *scientific research and education.* Proposals for the reform of the Fishery Authority consist of the suggestion that the existing Fishery Board should cease to exist, or, rather, that it should be "assimilated in form to that of other Public Departments," being "completely manned by Civil Servants and with a permanent head," and coming into relation with the industry through a Consultative Board.

The Memorandum before us gives a short account of the pre-war yield of North European sea-fisheries. In the year 1912 Europe took about 7000*l.* per 100,000 inhabitants, Norway 128,000*l.*, Germany 3000*l.*, Great Britain 29,000*l.*, and Scotland 73,000*l.* This position of Great Britain it is our duty to maintain.

The scheme for the organisation of scientific research and fishery education exhibits a degree of insight into the conditions of the industry and a familiarity with the problems involved such as no previous recommendations have disclosed. The whole situation has materially changed since pre-war days. Ought our participation in international schemes of fishery investigation to terminate? Should any scheme of scientific research aim at the co-ordination of the English, Scottish, and Irish Authorities? The Memorandum says "Yes" to both questions. British interests in North European fisheries are so outstanding that they call for adequate attention; some other nations may not be prepared to go on with the work of the International Council, and if they do the Continent will again become the centre of gravity of the organisation, while in the industry itself Great Britain will remain the predominant partner; and, finally, the expense of time and money entailed by the frequent conferences under the old scheme was unattended by proportionate results. But all this need not imply isolation in matters of investigation—only formal withdrawal from the existing scheme.

In place of the three national Fishery Departments and some of the local Fishery Committees, which before the war instigated scientific research, the Memorandum suggests a single central council having the control of the funds voted by Imperial Parliament. The Council ought to contain representatives of each national Department, of the Meteorological Office, of the fishing-vessel owners, and of the industrial concerns dealing with curing, preserving, by-products, transport, and refrigeration. Recognising the movement in the public mind towards devolution of authority and administration, the "vital importance of combining scientific research with industry," and the necessity for close co-operation between the expert and the *entrepreneur*, the drafters of the Memorandum regard centralisation in London as detrimental. "It could not be accepted." The Council, the head of which ought to be a chairman and director, a man conversant with fishery matters, "and not appointed for political reasons," would expend, direct and allocate the administration of funds, publish reports, memoirs, and results of research, advise on supporting scientific work carried on in unofficial laboratories, devise schemes of investigation and systems of statistical collection, conduct propaganda, appoint agents abroad, publish intelligence, and conduct a fishery journal.

But the Central Council would not establish laboratories or actually conduct scientific investigation. That would be the work of the English, Scottish, and Irish Fishery Departments, and of the Marine Biological Association of the United Kingdom (for "in respect that pure science is the fountain from which applied science draws its life and force, the Marine Biological Association should receive a generous grant yearly out of the funds received by the Central Council"). Each of these four organisations would establish and maintain laboratories, and conduct research in accordance with the schemes submitted to them and the funds allocated. They would also organise schemes of fishery education and co-operate with educational authorities for that purpose.

Some matters dealt with apply specially to Scotland. The Department should seek to develop the new Education Act, which appears to provide for continuation and technical instruction, but not for higher fishery education. For the latter purpose a college of fisheries at Aberdeen is suggested, similar in scope to the Scottish College of Agriculture. This would provide for the education—"that is now a clamant necessity"—of those holding responsible positions in industry in all subjects that are relevant. It would provide for training in research, conduct bureaux of scientific and economic information, maintain a museum, and carry on a sub-department for co-operating with local schools and "encouraging pupils of ability."

Here we have the real grip of essentials. "The future of the industry depends on knowledge"; "Nothing will so surely secure this as opportunities for scientific knowledge." If the outlined schemes for education and scientific research are carried out, "the Scottish fishing industry will continue to hold its high place among the nations of Europe."

NOTES.

THE inauguration of the first boring for petroleum in this country, which took place at Hardstoft, near Chesterfield, on October 15, was an event of more than economic interest by reason of the confirmation it may afford of the speculations of competent oil-field geologists of the existence of oil in this country. Forty American drillers are engaged on the first boring, but provision of the necessary plant for drilling ten wells has been made; seven of these drillings are to be made in the vicinity of Chesterfield. Each of the wells will be fully equipped for a maximum depth of 4000 ft., and the principal occurrence of oil is expected to lie between 2000 ft. and this maximum. Lord Cowdray, to whom the nation is so much indebted for the assistance he has rendered in this pioneer work, claimed that although in America such experimental drilling would be known as "wild-catting," yet it was more than justified by to-day's knowledge, but was not a case for exaggerated hopes. Such a word of caution was very necessary, for it is so customary to think of oil-wells as yielding prodigious quantities that the low average of some five tons a day per well throughout the world is not realised. Last year the importation of oil into this country was valued at more than 36,000,000*l*. Even if all the ten wells yielded the above average, the contribution to our national requirements would be very little, and the present enterprise must be regarded more as exploratory than as likely to furnish any adequate proportion of our requirements.

PROF. W. J. POPE, in giving the first Streatfeild memorial lecture at the City and Guilds Technical College, Finsbury, on October 17, selected for his subject "The Future of Chemistry." He reviewed the past and present states of chemical science and industry, and referred to the good work accomplished by men like Meldola, Armstrong, Streatfeild, and others in training the men who during the last four years have been instrumental in establishing a chemical industry on a sound basis, and have enabled us as a nation to produce all those materials necessary for the successful prosecution of the war, many of which, prior to 1914, were to be obtained only from enemy countries. These results were rendered possible by the existence of a small but efficient company of chemists, many of whom were formerly students at the City and Guilds Technical College, Finsbury. The lecturer, in referring to the splendid prospects which the future held for chemical industry, reminded the present students that it rested with them how far this rich heritage of possibilities handed down by the labours of two generations of chemists was explored and developed. Sir Edward Busk, in moving a vote of thanks to the lecturer, referred to the indifference which existed prior to the war regarding applied chemistry, an indifference connected, no doubt, with the immense accumulation of wealth and the general prosperity which had favoured us as a nation. We had been sharply roused from our apathy, and no doubt by this time we all had a just appreciation of the importance of chemical science to national security and prosperity.

WE announce with much regret the death on October 18, in the ninety-first year of his age, of the Rt. Hon. Sir Edward Fry, G.C.B., F.R.S., late Lord Justice of Appeal.

MR. D'ARCY POWER will take "Cancer of the Tongue" as the subject of his Bradshaw lecture at the Royal College of Surgeons of England on Thursday, November 14, at 5 o'clock.

AN address on "Past and Future of the Fight against Tuberculosis" will be given by Sir Malcolm Morris at the Royal Society of Medicine, Wimpole Street, at 8 o'clock on Monday, October 28, the occasion being the opening of the winter session of the Tuberculosis Society.

THE engineering gold medal of the North-East Coast Institution of Engineers and Shipbuilders has been awarded to Mr. Harry R. Ricardo for his paper entitled "High-speed Internal-combustion Engines," which was read before the institution on April 30 last.

THE death is announced, at fifty-one years of age, of Prof. Maxime Bôcher, professor of mathematics in Harvard University since 1904. Prof. Bôcher was president of the American Mathematical Society in 1909–10, and the author of several works on the theory of linear differential equations and related subjects.

MR. LEONARD C. HARVEY has returned from the United States after having carried out for the Director of Fuel Research a full investigation into the progress made in recent years in the application of pulverised coal for metallurgical and general industrial purposes for steam-raising in land and marine boilers and in locomotives on railways. His report will be issued as a Government publication by the Department of Scientific and Industrial Research at an early date.

THE third lecture of the series arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, October 30. The chair will be taken at 4.30 by Sir Wilfrid Stokes, K.B.E., president of the council, and an address on "The Functions of the Government in Relation to Industry" will be given by Mr. W. L. Hichens, managing director of Messrs. Cammell, Laird, and Co. Applications for tickets should be made to the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4

THE United States, like our own country, is already feeling the loss of its scientific men through the undiscriminating and brutal hand of war. Prof. J. F. Kemp records in *Science* (September 13) the death of Capt. John Duer Irving, of the 11th U.S. Engineers, editor of *Economic Geology*, and professor of that subject in the Sheffield Scientific School of Yale University. Prof. Irving followed his father, the late R. D. Irving, in paying special attention to deposits of metallic ores and useful minerals. The father was, perhaps, more drawn towards petrology, and his work for the U.S. Geological Survey may be better known than that of the younger man, who died from pneumonia in Flanders at the age of forty-four. It is part of the tragedy that the finest investigations of Prof. Irving will now be published posthumously. A bulletin by him and Dr. S. F. Emmons on the Downtown district of Leadville, Colorado, was issued in 1907. Dr. Emmons's death left the junior author in charge of the revision of the great monograph on Leadville, and the edition now in hand, recording a large number of new observations, will remain for scientific men as Prof. Irving's monument.

THE Wilberforce Museum, controlled by the Corporation of Hull, has recently received a promise of a valuable addition to its collections in a large series of Stuart relics presented by the Rev. W. C. Piercy. It consists of a large number of prints and oil paintings connected with the Stuart period, a miniature of Henrietta Maria, and a memorial ring of Charles I., with a tapestry, said to be of Gobelin manufacture, from the Bardo Palace at Turin, representing Charles I., Queen Henrietta Maria, and Charles II. as a boy. Besides these objects, there is a considerable collection of books relating to the Stuarts. These collections will revert to the museum after the death of Mr. Piercy and his wife.

IN the Journal of the Royal Anthropological Institute (vol. xlviii., part i.) Mr. H. Ling Roth concludes his elaborate monograph on primitive looms. In its earliest stages the loom is so apparently simple that it is very difficult to decide whether it was due to independent invention, inheritance from ancestors in a distant region, or transmitted from one race to another. Origin or invention must precede distribution or copying, and is consequently more remote and obscure than distribution, which in most cases is so obvious that it tends to increase the obscurity of origin. On the whole, Mr. Roth comes to the conclusion that some looms are of independent invention, while others are an inheritance or have been transmitted from one race to another.

Some new light on the proto-ethnology of the Malay Peninsula is thrown by excavations in caves at Lenggong, Upper Perak, conducted by Mr. I. H. N. Evans, the results of which are published in the Journal of the Federated Malay States Museums (vol. vii., part iv., June, 1918). Amongst other objects, some stone implements were discovered. Whether these had been subjected to a rubbing-down process still remains a matter of doubt. If we are to regard the specimens as being roughly blocked out and unfinished specimens of the Neolithic period, it is difficult to see into what peninsular type or types they are to be included. It is possible that the earliest occupants of these caves did not possess any pottery, but a little may have been in use in the period represented by these implements.

In *Man* for October Miss M. Murray discusses the question of the so-called "devil's mark," familiar to all students of European witchcraft. After a review of the evidence, the writer draws the conclusion that the mark was coloured, permanent, caused by the pricking or tearing of the skin; that the operator passed his hands or fingers over the place, and that the pain was severe and might last a considerable time. These facts suggest tattooing. Another form of the "devil's mark" was the "little teat." The description points to its being a natural phenomenon, the supernumerary nipple. Cases of polymastia or supernumerary breasts, and polythelia or supernumerary nipples, are constantly observed by modern scholars, and their occurrence is more common than is generally believed, and in many cases is unnoticed, unless well-marked in men or causing discomfort by functioning when in women.

In the *Eugenics Review* for October (vol. x., No. 3) Prof. J. A. Lindsay discusses the eugenic and social influence of the war. He concludes that "when we come to count up the gains and losses of the war, there can be little doubt to which side the balance will incline. The nation will have lost heavily in manpower, in brain-power, in capital, and in industrial resources. But there will be some not inconsiderable compensations. The nation will, we may hope, emerge from the great ordeal purged of some of its defects. Luxury will diminish, thrift will increase. Food production at home will have received a great stimulus. Education will be on a sounder basis. We shall be more teachable, less self-satisfied, readier to profit by example and by experience."

There is a general belief that it is a relatively easy problem to estimate a person's intelligence by looking at him; and teachers, physicians, and employers are often compelled to make judgments as to the intelligence of a given person with no more data than can be obtained from a rapid survey of his appearance; hence such phrases as "he looks bright" or "he looks stupid." Even in the law courts rough estimations of intelligence are sometimes required. In the *Psychological Review* (vol. xxv., No. 4) Mr. R. Pinter gives the results of an investigation he made for the purpose of testing the trustworthiness of these judgments. The author chose twelve photographs of children varying in intelligence from proved feeble-mindedness to unusually great ability, and asked groups of people to arrange the photographs in order of merit for intelligence. His groups consisted of physicians, psychologists, teachers, and miscellaneous people. He found that the group of psychologists was the most nearly correct, but that on the judgment of no one group or of no one person could any reliance be placed. Several observers were consciously influenced by children of their acquaintance whom a photograph happened to resemble, and irrelevant trivialities quite frequently biased the observer's judgment. The author concludes that, although perhaps a living person would be easier to judge than a photograph, nevertheless these haphazard judgments are too untrustworthy to be of practical value; and that, whether the observer be a teacher, physician, or employer, it would be better to use objective standards, and he recommends that the use of mental tests should be considerably extended.

The fourth and fifth parts of the Report of the Danish Oceanographical Expedition of 1908–10 to the Mediterranean and adjacent seas have just been published (Copenhagen, 1918). No. 4 deals entirely with several groups of the fishes collected—the shore fishes, the Stomiatidæ, Argentinidæ, Microstomidæ, Opisthoproctidæ, Mediterranean Odontostomidæ, Bramidæ, and Trichiuridæ. No. 5 is also biological, and describes the Mediterranean Scopelidæ; one group of Crustacea, the Hyperiidæ-Amphipoda; the sea-grasses; and the Algæ (except the calcareous species). The reports are wholly systematic, and particular attention is paid to larval and post-larval forms. Schmidt's biometric methods are applied in the descriptions of fishes, and very clearly drawn and printed tables and distributional charts are included. The report is a model of careful editing and admirable printing.

The Bulletin of the Madras Fisheries Department (No. 11, Government Press, Madras, 1918, edited by Mr. James Hornell) contains a very interesting paper by Sir F. Nicholson, Honorary Director of Madras Fisheries, on carp cultivation in Bavaria. There are thousands of ponds in the kingdom, and they are regarded as more profitable than the same area of good land. As a rule, they are natural hollows, which nearly empty in the winter. About once in ten years they are cropped with oats or some other cereal. They receive drainage from the surrounding area of cultivated land, and the liquid part of the farm drainage is deliberately led into them. Shade is undesirable, and a high water temperature very favourable. The ordinary pond vegetation exists, with a very abundant plankton. The fish are actually cultivated, like trout for stocking purposes in this country. They are fed artificially by cereals, seeds of lupins, maize-cake, fish-meal, bad potatoes, oil-cake, vegetables unfit for the table, etc. In one farm, not the best, the output in one year from a pond of 88 acres was 11,000 lb. of fish. The methods are strongly recommended for adoption in India.

The vital relation of economic ornithology to agriculture and horticulture is sufficiently obvious to warrant a more extensive and more scientific study than it has yet received. The subject is an intricate one, and much harm has been done by hasty generalisations based upon very inadequate and imperfectly collected data. Few workers have contributed more usefully to the subject than Dr. W. E. Collinge, and the report on his recent investigations, which is published in the September issue of the *Journal of the Board of Agriculture*, is deserving of wide notice. In most previous work the numerical or gravimetric system of estimating the food contents of birds' stomachs has been followed, but Dr. Collinge roundly condemns this in favour of the volumetric method or percentage valuation by bulk. As the result of examinations of 3670 adult birds and 595 nestlings, embracing nine species of wild birds, he draws the conclusion that only two of these species, viz. the house-sparrow and the wood-pigeon, are distinctly injurious, and should be subjected to strong repressive measures. Two others, viz. the rook and the sparrowhawk, are too numerous, and consequently injurious over wide areas, whilst the missel-thrush is too numerous in certain localities; these species could be adequately reduced by a temporary withdrawal of protection. The remaining four species, viz. the skylark, green woodpecker, kestrel, and lapwing, are highly beneficial, and should receive every protection.

THE first annual report of the official seed-testing station of the Board of Agriculture, which is issued in the Board's *Journal* for September, affords abundant justification for the creation of the station in November last. In the eight and a half months of the station's existence up to July 31 no fewer than 7744 samples were dealt with, of which 5676 were sent by seedsmen and 1553 by growers. In course of time the proportion of the latter class will doubtless steadily increase as the facilities provided become more widely known amongst farmers and allotment-holders. More than forty species of seeds were tested, the most numerous being cereals, grasses, clovers, turnips, mangolds, and onions. The report clearly indicates that much worthless seed is liable to get into the hands of farmers, about 1 per cent. of the samples showing a germination of 5 per cent. or less. The quality of a few kinds of seed would seem to have been decidedly below the average of recent years, *e.g.* vetches, English red clovers, trefoil, meadow fescue, timothy, scarlet runner and French beans. Dodder was very prevalent in red clovers, especially in those of Chilian origin, and its presence in samples of other leguminous species is evidence that sufficient attention is not yet paid to the elimination of this parasite. The general significance of the results as outlined in the report merits the most careful consideration of both seedsmen and growers.

WE have received a copy of the register of earthquakes felt or recorded in the Philippine Islands during the year 1917 (U.S. Weather Bureau for December, 1917). The number of earthquakes catalogued is 146; most of them were of moderate intensity. Only two were strong enough to damage buildings slightly, yet, though their epicentres were situated within or close to the Philippine Islands, both were registered at seismological stations all over the world.

IN a paper on the atmospheric scattering of light, which constitutes Publication No. 2495 of the Smithsonian Miscellaneous Collections, Mr. F. E. Fowle, of the Astrophysical Observatory of the Smithsonian Institution, gives the results of an examination of the data collected at Mount Wilson between 1910 and 1916. If the fraction of the light of given wave-length incident at the outer limits of the atmosphere which penetrates to the earth's surface be called the transmission coefficient, this coefficient is found to vary for dry air from about 0·6 at the blue to about 0·9 at the red end of the visible spectrum, its value varying with the inverse fourth power of the wave-length. In addition, there is a slight haziness which reduces the coefficient by 0·5 to 3 per cent. in normal years. The coefficient for dry air is entirely accounted for by the gas molecules according to the theory given by Rayleigh. The coefficients for water-vapour vary from 0·9 to 0·98 over the same range, and follow the same law of variation with wave-length. The absorption is, however, fifty times that to be expected on Rayleigh's theory. The haziness due to the vapour reduces the transmission about 2 per cent. in all parts of the spectrum.

THE Central Argentine Railway has a present mileage of 3300, and serves the northern portion of the Argentine. It has the distinction of being the first of the great railway lines in the Argentine to adopt the modern method of dealing with suburban traffic, and this fact lends interest to a series of illustrated articles in *Engineering* descriptive of the electric traction system employed. Messrs. Merz and McLellan have acted as engineers in conjunction with Messrs. Livesey, Son, and Henderson, and the whole of the apparatus used in connection with the electrification was manufactured in Great Britain. The complete electrification works for the suburban system include a power station of 15,000-kw. capacity, 57 miles of high-tension transmission cables, four traction sub-stations with 14,000 kw. of converting plant, and the electrical equipment of 100 miles of single track. Power is produced in the generating station as three-phase current at 20,000 volts, with a periodicity of 25 cycles, transmitted to the sub-stations, converted to direct current at 800 volts, and supplied to the trains through a third rail. The power plant includes six Babcock and Wilcox water-tube boilers with under-feed stokers, four horizontal reaction turbines with high- and low-pressure cylinders by Messrs. C. A. Parsons and Co., Ltd., together with alternators, transformers, and motors by the same firm.

Engineering for October 18 contains an account of an interesting process for producing wheels and discs by rolling which is in operation at the works of the Cambria Steel Co., Pa. The method, which is due to Mr. E. E. Slick, consists in cutting "cheeses" off 11-in. to 20-in. rolled bars, and then converting these blanks into wheels or discs by a special form of rolling mill, of which drawings are included in the article. The blanks are cut from the hot bar by eccentric shears having cutters with cam-shaped edges, which approach and recede from each other as the cutters rotate. It is this approach of the two edges during a rotation which effects the cut by shearing on a bar placed between the two. The blanks are then reheated and punched so as to leave a hole nearly half-way through them, into which a loose pin is fitted, which serves to centre the blank in the subsequent rolling operation. The rolling mill consists of two shafts set at a slight angle to each other. At adjacent ends each shaft carries a die corresponding with the wheel-form required, and between these dies the blank is placed. One die is fixed axially, and the other can be traversed axially by hydraulic rams. The total thrust exerted by these rams is about 3,000,000 lb. It is claimed that the wheels produced by this process are of uniform texture, and that any piping which may have existed in the centre of the round bar remains in the centre of the punched wheel, and is ultimately removed when the wheel is pierced to take the axle.

WE regret that a reference in a note in our issue of October 10, p. 111, conveyed the impression that the Institute of Chemistry had failed in its efforts to increase its activities. Mr. R. B. Pilcher, registrar and secretary of the institute, informs us that more than one hundred new fellows and more than 650 new associates have been elected since October of last year. All that the writer of our paragraph intended to suggest was that the institute, by opening its doors more widely, would obviate the necessity for the formation of new organisations in the chemical profession; indeed, events are already beginning to show the undesirability of having several organisations representing the profession. We are glad to take this opportunity of congratulating the institute on the success of its progressive policy.

MESSRS. LONGMANS AND CO.'s new announcement list contains the following books relating to science:—"Life of Frederick Courtenay Selous, D.S.O.," J. G.

Millais, with sixteen full-page illustrations; "Ships' Boats: Their Qualities, Construction, Equipment, and Launching Appliances," E. W. Blocksidge; and a new and revised edition of "Recent Advances in Physical and Inorganic Chemistry," Dr. A. W. Stewart, with an introduction by the late Sir William Ramsay, K.C.B., F.R.S., illustrated.

MR. F. EDWARDS, of 83 High Street, Marylebone, has just issued Catalogue No. 384 of books dealing with a variety of subjects, but mainly architecture, printing and bibliography, and bookbinding. The sections appealing more especially to readers of NATURE are those relating to archæology, gardens, and the proceedings of many provincial scientific societies.

MESSRS. J. M. DENT AND SONS, LTD., have received a licence from the Controller of Patents to publish a translation of "The Biology of War," by Prof. G. F. Nicholai, the former holder of the chair of physiology in Berlin University, who, after imprisonment in Germany for his opinions, escaped to Denmark by aeroplane.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET.—L. v. Tolnay gives the following elements of this comet in *Astr. Nach.* (No. 4961); he has computed planetary perturbations, including those of Mars, to which the comet made a near approach at the beginning of 1912:—

$$T = 1918 \text{ Nov. } 16{\cdot}6818 \text{ G.M.T.}$$

$$\left.\begin{array}{l}\omega = 352^\circ\ 23'\ 0{\cdot}73''\\ \Omega = 77^\circ\ 1'\ 47{\cdot}71''\\ i = 30^\circ\ 29'\ 29{\cdot}01''\end{array}\right\}1925{\cdot}0$$

$$\phi = 37^\circ\ 57'\ 20{\cdot}77''$$

$$\mu = 513{\cdot}90816''$$

The following ephemeris is from a Marseilles Circular (for Greenwich midnight):—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Nov. 2	6 33 30	2 20	0·1478	9·7978
6	6 38 58	4 52	0·1463	9·7766
10	6 44 1	7 44	0·1454	9·7561
14	6 48 35	10 57	0·1449	9·7367
18	6 52 37	14 30	0·1449	9·7190
22	6 56 3	18 24	0·1453	9·7035
26	6 58 49	22 36	0·1462	9·6910
30	7 0 49	27 2	0·1476	9·6822

Harvard Bulletin (No. 669) gives the following observations made at the Yerkes Observatory by Mr. Van Biesbroeck:—

G.M.T.	R.A. h. m. s.	S. Decl. ° ′ ″
Aug. 31·89146	4 39 19·15	14 1 50·0
Sept. 5·91563	4 45 18·78	13 29 47·4

The comet had a diffused elongated nucleus in P.A. 95°, a tail 40″ long in the same direction; its magnitude was 13; it may rise to the 9th magnitude in November, being fairly near the earth.

WOLF'S COMET.—The following is a continuation of M. Kamensky's ephemeris for Greenwich midnight:—

	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ
Nov. 2	21 4 59	2 50 N.	0·2138	0·0608
6	21 13 52	1 48	0·2112	0·0677
10	21 23 8	0 51 N.	0·2088	0·0749
14	21 32 46	0 1 S.	0·2066	0·0824
18	21 42 42	0 49	0·2048	0·0904
22	21 52 56	1 31	0·2032	0·0986
26	22 3 24	2 8	0·2018	0·1072
30	22 14 3	2 40 S.	0·2008	0·1159

The comet is likely to be of the 10th or 11th magnitude.

SOLAR-LINE DISPLACEMENTS AND RELATIVITY.—A further contribution to the study of solar-line displacements in connection with Einstein's theory of relativity has been made by Mr. J. Evershed (*The Observatory*, vol. xli., p. 371). Thirty of the lines composing the cyanogen band λ 388 were carefully selected for observation, and their displacements determined by comparison with the corresponding lines in the carbon arc. The provisional mean values for the shifts are +0·004 A at the centre of the disc, and +0·006 A at the polar limbs. There appears to be a curious systematic difference in the results for the north and south polar limbs, the former agreeing approximately with the centre of the disc, while the latter consistently showed the much larger displacement of +0·008 A. The displacements as a whole are larger than those found by Dr. St. John, but they are still, on the average, not much more than half the predicted gravitational effect, whilst for iron lines the shifts are in many cases twice as great at the limb as is required on the relativity hypothesis. In explanation of the limb displacements Mr. Evershed suggests that the effect may possibly be due to the unsymmetrical shading towards the red of the majority of the Fraunhofer lines, which would be emphasised at the limb in consequence of the longer path of the photospheric light through the absorbing vapours. A large proportion of iron lines have, in fact, been found to be very slightly shaded towards the red in the laboratory spectrum. In agreement with Dr. St. John, Mr. Evershed considers his results unfavourable to the theory of relativity.

SCIENTIFIC AND PRACTICAL METRIC UNITS.

WE have received a communication from Dr. John Satterley, of the University of Toronto, with reference to Sir Napier Shaw's article on "Units and Unity" in NATURE for June 27, in which he complains of "the bewildering array of powers of ten" that hamper the C.G.S. system of electro-magnetic units and the practical units of electricity. Dr. Satterley makes the same complaint of other measures based on the metric system, which he admits is admirable for purposes of scientific measurement, but not for everyday use until it is simplified and the names of its units are shortened. He cites the milliwatt as representing a complication so intricate that nobody but a professional metricist knows what it is.

The communication represents the impossible position which some teachers of science practically take up consciously or unconsciously. The introduction of C.G.S. units into scientific measurement is an accomplished fact; and if scientific measurement is to be the headlight of practical life, it is absurd for the ordinary sensible man to be kept in ignorance of the units with which scientific men work. It has been remarked in some quarters that Sir Napier Shaw's article should have been addressed to the uninformed and unconverted: that readers of NATURE were all agreed upon the question. But if the agreement is only with the reservation that the organised system of physical units as it exists is reserved for the inner circles of scientific society, while the inch and the English system are good enough for the ordinary dealings of everyday life, it is obvious that the practical applications of science in this country must continue to be crippled as heretofore.

The beginning of Dr. Satterley's complaint is that "metricists are continually inventing new units—practical units (so-called) which are multiples of the centimetre, the gram, and the dyne." Who are the delinquents in that case we do not know. Dr. Satterley professes his ignorance of the millibar. He may not have seen Prof. V. Bjerknes's work published in Washington, or the discussions that have taken place upon it in meteorological publications. He should not, however, complain if those whose scientific lives depend absolutely upon measures of the pressure of the atmosphere feel necessities which he does not share. If he himself is unaware of the literature of the subject, he can get the information which he seeks very simply by asking his colleague who is charged with the duty of expounding the important subject of dynamical meteorology in the University of Toronto just as he would ask a mathematical colleague if he came across an equation which he could not solve. No doubt the powers of ten are awkward, and those that are superfluous will pass away with practical use, but not before.

The general question of the reform of our system of weights and measures is raised again by the Ministry of Reconstruction in the report of Lord Selborne's Sub-Committee appointed to consider the methods of increasing home-grown food supplies in the interest of national security. One difficulty in the way of home-grown supplies to which the report directs attention is the chaos of different units and the divergence of standards of measurement for agricultural produce. The Sub-Committee proposes, therefore, that a uniform standard of weight should be laid down on which alone sales and purchases of agricultural produce, other than liquids and certain market-garden produce, should be legal; with standard measures also for liquids and of number for market-garden produce habitually sold in that way. Now that the sale of produce is no longer between the local grower and the local shopkeeper, but is so organised that narcissus grown in Scilly may be sold as cut-flowers in Aberdeen, the old conventional methods of sale by the habit of local pottle or basket are certainly out of date.

There is no doubt that selling by weight is the scientific mode of procedure, and for dealing with shiploads the only practicable method. Also for the final distribution of the stock to small purchasers weighing is the only satisfactory basis of a modern bargain. For the intermediate stage between the large producer and the small buyer the measure of capacity that is based upon convenient packing for transport is very serviceable. When produce must be put into sacks, or pots, or flats in order to get it to market it is in so handy a form for sale and so badly arranged for weighing that some scale of equivalents must come into vogue either by agreement or by law, and it should be the object of legislation to make that easy and not difficult; just as wherever beer is sold it must be sold by the barrel, whether the barrel contains 36 gallons or 163 litres.

The really debatable point, however, about a revised scheme of selling produce by weight is what the standard of weight shall be. Here the ton and the pound are the rivals, just as the pound (in another sense) and the penny are rivals in decimal coinage. There is such a convenient bridge to the metric system through the ton that an English name for the kilogram would be the best solution. If anyone can produce a monosyllable that would be generally adopted as a designation of a weight of about 2·2 lb., the rest might be comparatively easy. "Kilo" is neither sufficiently euphonious nor sufficiently exclusive.

Sale by number is another matter with a great history of its own, depending upon the art of bargaining. When we have got rid of long hundreds, and bakers' booksellers' dozens, and scores which are not twenties, we might then agree that an immense amount of bookkeeping would be saved if net prices could be protected against the inroads of discounts for prompt cash, but that is probably as deep down in human nature as giving back a shilling for good luck when one sells a pig.

FRUIT INVESTIGATIONS AT LONG ASHTON.[1]

THE report of the Agricultural and Horticultural Research Station of the National Fruit and Cider Institute, Long Ashton, near Bristol, gives a record of the work done during the year and the changes in organisation brought about as the result of the war. Fortunately, the investigations still continue, though much of the time of the staff is devoted to the work of the Food Production Department; and, still more fortunately, arrangements are in progress whereby the station will be able further to develop after the war. On its establishment in 1903 the station had to be content with 15 acres of land; since that date the area has gradually expanded until at the beginning of this year it was 28½ acres. Most of the land, however, is now planted up with fruit or covered with buildings, and no new experimental work requiring land could be undertaken at the station itself. An opportunity for increasing the area of available land has recently occurred, and arrangements have been made whereby this is to be extended to 53 acres, while an option has been secured that will enable another 200 acres to be taken over if necessary. The director is to be congratulated on having made these arrangements for future developments.

The report consists of a series of papers by the director, Mr. B. T. P. Barker, and the staff, Messrs. Otto Grove, G. T. Spinks, A. H. Lees, and C. T. Gimingham. The subjects are varied; there are several pathological papers dealing with diseases or pests of fruit-trees, one on apple stocks, and another on cider-apple jelly. The production of jelly from apples involves many interesting problems, the chemistry of which is not fully understood. Cider apples and perry pears are not normally used for food in this country except in times of scarcity, when certain varieties are taken by the jam-makers, and to a less extent for dessert and cooking purposes. In the case of apples only the "sours" are used in this way, the "sweets" and "bitter-sweets" being exclusively reserved for cider. The "sours" contain a good deal of malic acid, the amount exceeding 0·45 per cent. in the juice; they yield a jelly without difficulty. The "sweets" and "bitter-sweets" have hitherto proved unsuitable for jelly-making, but Mr. Barker has now fortunately discovered the proper conditions for manufacture. The juice is first extracted, and is then concentrated in a Kestner evaporator until the malic acid constitutes between 1 and 1·5 per cent. of the whole; then sugar is added until the total quantity present amounts to 65 per cent. In practice a certain amount of blending of juices is desirable, so as to ensure that the proper concentration of malic acid shall be readily obtained. It is, of course, possible to obviate any addition of sugar by carrying the evaporation far enough; in this case it would have to go to one-seventh of the original value of the juice, the average sugar content of which is about 10 per cent. On the whole, it is found cheaper to add the sugar.

A prolonged investigation is being made into the various "stocks"—the seedling trees on which grafts are grown. Of these "stocks" there are great

[1] Annual Report of the Agricultural and Horticultural Research Station National Fruit and Cider Institute, Long Ashton, Bristol, 1917.

numbers, but Mr. Barker proposes to treat them as a series of hybrid varieties produced by much natural inter-crossing, in the first instance between the botanical species from which the ordinary cultivated apple has arisen, and, later, between the varieties resulting from the earlier hybridisation. The main problem is to determine the nature of the influence of the stock on the resulting fruit-tree, and, in particular, whether it is simply mechanical in nature and regulated by the morphology of the root system, or whether there is a definite physiological influence, the nature of which is determined by the character of the seedling. If the latter is a factor, the problem is, of course, extraordinarily complicated, but there are opened up possibilities of striking developments in the culture of fruit. Further work on this important subject will be awaited with interest.

A NEW GRAPHIC METHOD IN NAUTICAL ASTRONOMY.

A NEW departure of some little interest has been recently taken in America in the publication by the United States Hydrographic Department of a new chart, or diagram, for finding readily by a simple graphic process hour angle or azimuth at sea. So far as azimuth is concerned, a diagram of this nature, known as Weir's Azimuth Diagram, has been in use for many years, but in that case the hour angle is made use of as a datum, whereas in the new diagram the altitude takes the place of hour angle as argument; and, as an altitude can be observed at sea with much less trouble than hour angle can be deduced from chronometer time, some labour is saved by its substitution.

The construction of the diagram, which is due to the inventive genius of Mr. G. W. Littlehales, of the U.S. Hydrographic Department, is based upon a function of the angle very generally employed by navigators, but not much known outside nautical circles, called the haversine. A formula very generally employed in spherical trigonometry for finding an angle of a triangle from three sides given is

$$\sin^2\frac{A}{2} = \frac{\sin(s-b)\sin(s-c)}{\sin b \sin c}.$$

The practical application of this formula was very much simplified about a century ago by the introduction into the nautical text-books of a new table which gave the value of the logarithm of the square of the sine of one-half the angle, and was therefore called the "sine square" table. A little later, since

$$\sin^2\frac{A}{2} = \tfrac{1}{2}(1-\cos A) = \tfrac{1}{2}\text{ vers A},$$

the name of haversine, or half versine, suggested itself for the new function of the angle, and as such it is generally known to-day.

The particular formula on which the diagram is based was proposed about ten years since, and is as follows:

$$\text{hav}(a) = \text{hav}(b \sim c) + \{\text{hav}(b+c) - \text{hav}(b \sim c)\}\text{ hav A}.$$

If the sides b, c be regarded as constants, a, A being variables, this expression takes the form

$$y = mx + c$$

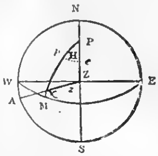
—that is, of the equation to a straight line.

This formula suggested to the inventor the notion of a square chart, with sides graduated according to the values of a series of natural haversines, by means of which, having given the altitude and declination of a body and the latitude of place, hour angle and azimuth might be found by simple inspection. Upon such a chart, by drawing a straight line through two points readily determined, a connection would be established, in one case between the hour angle and zenith distance, in the other between azimuth and polar distance, so that, one of a pair being given, the value of the other could be taken approximately from the chart.

The Triangle of Position in Nautical Astronomy.

The diagram which follows exhibits on the plane of the horizon what is known as the "triangle of position," in which

PZ, the co-latitude $=90^\circ-$lat. or c.
PX, the polar distance $=90^\circ\pm$dec. or p.
ZX, the zenith distance $=90^\circ-$alt. or z.
ZPX, the hour angle $=\text{H}$.
PZX, the azimuth $=$Z.



The general formula adapted to this triangle gives for hour angle

$$\text{hav } z - \text{hav}(p \sim c) = \{\text{hav}(p+c) - \text{hav}(p \sim c)\}\text{ hav H},$$

the polar distance (p) and co-latitude (c) being considered as constants.

The small diagram given below will perhaps serve to explain the process adopted. The side is only 3 in. in length, compared with 2 ft. in that issued for practical use. In the actual chart, again, a system of "grillage," by means of lines drawn at short intervals parallel to the sides of the chart, enables the value of an angle to be read off to the fraction of a degree at sight, whereas in the small diagram the graduations of the sides are equal, and the points marked indicate the angles corresponding with successive values of the haversines at intervals of 0·125.

Hour Angle and Zenith Distance.

Example 1.—At a place in lat. 60°, when the sun is on the equator, find zenith distance at 4h. P.M., hour angle at setting, and at the end of twilight.

Rule.—On left-hand margin mark the point corresponding with ($p \sim c$), *i.e.* of meridian zenith distance at upper transit, and on right-hand margin the point for ($p+c$), or meridian zenith distance at lower transit. The line joining these points is the graph required, hour angle for any position being read off at foot of chart, and zenith distance on margin.

Here polar distance $(p) = 90°$, co-latitude $(c) = (90° - 60°) = 30°$.

Therefore $(p-c)$ for left margin $= 90° - 30° = 60°$.
,, $(p+c)$,, right ,, $= 90° + 30° = 120°$.

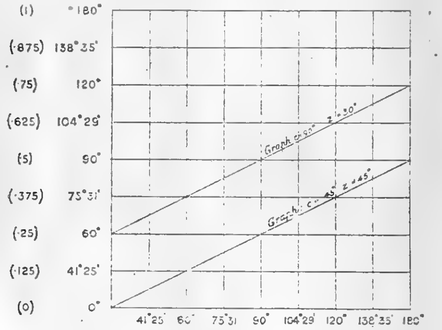
The graph being drawn accordingly, at 4h., or 60°, read off at foot of chart, we have zenith distance 73° 31′ on margin. When the sun is setting the zenith distance is 90°, and the hour angle is also 90°, or 6 hours. To find the hour angle at the end of twilight —that is, when the sun has a depression of 18°—we have to draw the parallel for 90° + 18°, or 108°. The graph intersects this in the point (*a*), which would be found on measurement to correspond approximately with 8h. 33m. P.M.

Azimuth and Polar Distance.

Interchanging polar distance (*p*) and zenith distance (*z*), the procedure will be very much as before.

Example 2.—At a place on the equator find the azimuth of bodies of declination 14° 29′ N., 0°, 14° 29′ S., the altitude in each case being 60°.

Rule.—On left-hand margin mark $(z \sim c)$, and on right-hand margin $(z+c)$. Join these points, and azimuth for any position is read off on base, and polar distance on margin.



Here $(c-z) = 90° - 30° = 60°$, $(c+z) = 90° + 30° = 120°$. For declination 14° 29′ N., we have polar distance 75° 31′, and azimuth N. 60° W.; for declination 0°, polar distance is 90°, and azimuth N. 90° W.; for declination 14° 29′ S., polar distance is 104° 29′, and azimuth N. 120° W. or S. 60° W.

The following is an example of the converse case in which declination is obtained from azimuth:—In latitude 45° N. find the declination of a body which passes the prime vertical at an altitude equal to the latitude of place. For $(z-c)$ we have the value zero, so that the graph passes through the origin, while $(z+c) = 90°$. If the bearing is 90°, we have polar distance 60°, so that declination is 30° N. If the azimuth is 60°, it is also evident from the diagram that polar distance is 41° 25′, and declination 48° 35′ N.

The deduction of declination from observed altitude and approximate azimuth is of value at sea to identify an unknown star.

The most obvious use of the diagram is to supply an exceedingly simple graphic method for azimuth. In theory the diagram can be used with equal facility for hour angle. But in the latter problem much greater accuracy is required than in the other, and the diagram necessary would have to be upon too large a scale to be available for ordinary use at sea. It is quite possible, however, that another kind of navigation may become a matter of daily experience ere long, viz. the long-distance navigation of the air, and that in this form of navigation, which will undoubtedly possess many features peculiar to itself, the diagram may serve generally not only for azimuth purposes, but also for those of hour angle.

In the words of the inventor of the diagram:—"The feasibility thus disclosed of framing a nautical astronomy in which all requirements will be subserved by a single trigonometrical table, like the table of haversines, No. 45 in the *American Practical Navigator*, invested the subject with interest from the point of view of aerial navigation, because this formula, if successfully represented in graphical form, might provide the aerial navigator with the equivalent of a volume on nautical astronomy in a form simple enough to fulfil the instant needs of flight." H. B. G.

EXPERIMENTAL STUDIES OF THE MECHANICAL PROPERTIES OF MATERIALS.[1]

THE general purpose of experiment on materials is to distinguish between the fit and unfit, the suitable and unsuitable materials for the various requirements of the structural and mechanical work of the world. The special object of the engineer in testing materials is to obtain a rational basis for proportioning structures and machines so that they may sustain the straining actions to which they are subjected without fracture or prejudicial deformation, and at the same time without waste of material. Nor is there any finality in such testing, for new alloys, new heat treatments, new conditions of use are always making fresh investigation necessary. In the next place, the mechanical properties of materials desired and assumed in designing are embodied in specifications. Thence arises a second occasion for experiment. Tests of reception or inspection tests are necessary to determine whether material supplied reaches the required standard. With the widening of the sources of supply, an engineer can no longer depend merely on the reputation of the seller, but must make his own tests.

Early Researches.

There are two methods, said Roger Bacon in the thirteenth century, by which we acquire knowledge—argument and experiment; and he proved the fertility of the method of experiment in contrast with the barren dialectics of his time. But it was some centuries later before anything was done to ascertain by experiment the data required by the engineer in using materials of construction. Yet there is no subject of greater importance to engineers, or of more intellectual interest, than the study of the mechanical properties of materials which fit them for use in construction. Nor is there one which more deeply concerns the general public who depend on the product of machinery and travel on railways.

The earliest known experiments on the strength of materials were made by Galileo[2] in 1638, and not long after Muschenbroek,[3] of Leyden, made many tests on a small scale, some of which are quoted in Barlow's "Strength of Materials." Galileo knew nothing of elasticity, but he determined the tenacity of copper and started an inquiry into the strength of beams, giving a solution partly right, partly wrong.

[1] From the Thomas Hawksley Lecture delivered before the Institution of Mechanical Engineers on October 4 by Dr. W. Cawthorne Unwin, F.R.S.

[2] Fontenelle, "Histoire de l'Académie des Sciences," 1702.

[3] "Introductio ad cohærentiam corporum firmorum," 1729; Barlow, "Strength of Materials," 1867, p. 3.

A step of the highest importance practically and theoretically was the publication in 1678, by Robert Hooke, "an Englishman of great genius but unpleasant temperament," of the empirical law that stress is proportional to strain.[4] Then in 1680 Mariotte, who independently discovered Hooke's law, indicated that the resistance of a beam is due to tension on one part and thrust on the other part of a section. Coulomb,[5] later, more scientifically obtained the equation of equilibrium by resolving horizontally the forces at a cross-section and equating the moment to that of the external forces on either side of the section.

In 1807 Thomas Young[6] defined the coefficient of elasticity or Young's modulus—an epoch-making advance because of the clearness it introduced into elastic reasoning. Arthur Schuster says that Young was probably, next to Leonardo da Vinci, the most versatile genius in history, and Helmholtz said that he was one of the most clear-sighted men that ever lived.

Early Practical Testing.

In the latter half of the eighteenth century a group of distinguished engineers and architects concerned in constructing a bridge over the Seine and the Pantheon or Church of St. Geneviève at Paris, finding the need for information, built testing machines of 20 to 100 tons capacity. Among them were Perronet,[7] Rondelet,[8] Gauthey,[9] and Girard.[10]

In 1817 Peter Barlow published an essay on the strength of timber and other materials founded on tests made at Woolwich. In 1825 Navier,[11] charged with the construction of a suspension bridge at Paris, required all the members to be subjected to a proof load of 10 tons per sq. in., and about 4000 pieces were tested with loads up to 70 tons. Navier had also made a great advance in theory in first investigating the general equations of equilibrium of an elastic solid.

It will be already clear that knowledge of materials was progressing along two independent lines—that of experiment and that of analysis. In the latter half of the eighteenth century mathematicians of the highest rank were applying themselves to the problems presented by the resistance and deformation of solid bodies. But mathematics is a kind of mill the product of which depends on the data with which it is fed. While experimental data were wanting, there were errors and misunderstandings in the theoretical investigation of elasticity. Prof. Love[12] says that in 1820 "the fruit of all the ingenuity expended by mathematicians on elastic problems might be summed up as—an inadequate theory of flexure; an erroneous theory of torsion, an improved theory of the vibrations of bars, and the definition of Young's modulus." But practical engineers had at this time accumulated considerable empirical knowledge of the resistance of materials. No one can overrate the importance to the engineer of theoretical researches in applied mechanics, but that branch of science is outside the purpose of this lecture.

Considerable advances in knowledge of strength of materials were made by Eaton Hodgkinson, who, though largely self-taught, had considerable mathematical ability and skill in observation. The precise position of the neutral axis of the cross-section of a beam seems to have been first demonstrated in a paper on transverse strain and strength of materials in 1822.[13] Between 1847 and 1853 he was professor of engineering at University College, London. In 1830[14] he carried out the well-known experiments on the most economical form of cast-iron beams, and in 1840 and 1857[15] he published researches on the strength of columns which form the basis of practical rules still in use. Though Hodgkinson's apparatus was rough, he so designed his tests that the results were accurate to a small limit of error.

The Conway and Menai Bridges.[16]

A great advance arose out of the circumstances attending the construction of the Menai and Conway tubular bridges. A railway had to be carried over spans not before accomplished for such work. Robert Stephenson imagined a suspension bridge with platform stiffened by wrought-iron girders, and there still exist in the piers of the Menai Bridge arrangements for supporting chains. Early, however, Sir William Fairbairn, from experience with ships, formed the opinion that girders would support themselves without chains. Much knowledge was found to be wanting, and very extensive experiments on a large scale were carried out in 1845–48, in which Fairbairn, Hodgkinson, and Edwin Clark assisted, and many scientific authorities were consulted. There was a great clearing-up of ideas as to the laws of transverse strength, especially in the case of built-up structures, and as to provision against buckling of members in compression—a fundamental question, as we have learned in the case of the Quebec Bridge.

The most novel expedient was the testing of a model of the Menai Bridge, one-sixth of full size. The model was of 75-ft. span and 4½ ft. deep. It was broken six times by dead weight, being repaired where weakest after each fracture. In this way its strength was increased from 35·5 to 86·1 tons, or, including its own weight, from 38 to 89 tons. Hence was deduced a law for geometrically similar tubes, namely, that the strength increased only as the square of the linear dimensions, but the weight as the cube. It follows that there is a limit of increase of dimensions for a girder of any given type and material at which the stresses due to the weight of the structure become equal to the safe working stress on the material—a limit approached in some modern bridges.

The Britannia and Conway bridges were successfully completed, and gave rise to the types of girder bridges which have prevailed from that time. But it is interesting that Eaton Hodgkinson almost to the last considered that suspension chains would be necessary, and Edwin Clark states that with few exceptions scientific men either remained neutral or ominously shook their heads and hoped for the best.[17]

Effect of the Introduction of Steel.

Wrought-iron was a material of tolerably uniform quality, but steel varies in its properties through a wide range, and in the early days was sometimes treacherous. Hence came about the demand for much more general and systematic testing. In 1858 Messrs. Robert Napier and Sons proposed to use steel in some high-pressure boilers. Doubtful as to the quality of the so-called homogeneous metal and puddled steel then manufactured, they employed Mr. David Kirkaldy to make tests which, it is believed under the advice of

4 "De potentia restitutiva." (London, 1678.)
5 "Essai sur une application des règles de maximis et minimis," Mém. par divers savans, 1776.
6 "Lectures on Natural Philosophy and the Mechanical Arts." Lecture III., 1807.
7 Lesage, "2nd Recueil de Mémoires des Ponts et Chaussées," 1808, p. 151.
8 "Traité de l'art de bâtir," 6th ed., 1830.
9 "Œuvres de Gauthey," 1909, p. 269; *Journal de Physique*, de l'Abbé Rozier, 1774, p. 402.
10 "Traité analytique de la résistance des solides," 1798.
11 "Notice sur le pont des Invalides," p. 284.
12 "Treatise on the Theory of Elasticity," 1892, p. 5
13 Memoirs of Manchester Philosophical Society, vol. iv.
14 *Ibid.*, vol. v.
15 Phil. Trans.
16 "Britannia and Conway Bridges," Edwin Clark, 1850.
17 *Loc. cit.*, vol. i., p. 298.

Rankine, covered a wide range. The results were published in 1862.[18] The testing machine was a single-lever machine, with no adequate means of taking up the strain during loading. The investigation led to the construction by Mr. Kirkaldy in London of a large machine of about 400 tons capacity, and the establishment of the first testing laboratory where tests were carried out for anyone requiring them. No doubt Mr. Kirkaldy's research had much to do with the adoption of the tensile test as the usual test of reception for iron and steel. From general considerations it might be argued that a torsion test or a shear test would have answered equally well.

Combined Stresses.

A branch of the subject on which our experimental knowledge is still imperfect is the resistance to combined stresses; for instance, the case of combined bending and torsion, or combined hoop and longitudinal stress. The most important investigation is that of Guest in 1900,[19] in which the yield-point was determined in cases of thin tubes subjected to combinations of tension, torsion, and internal fluid pressure. The result has been the general adoption in calculating crank-shafts of the theoretical formula for the equivalent bending moment M_e, due to a bending moment M and twisting moment T,

$$M_e = \sqrt{(M^2 + T^2)},$$

which is usually termed Guest's law. No tests of varying or alternating combined stresses have been made, and there is here an important field for future research.

In this review of experimental work it is not possible to pass over the researches of a remarkable man, Johann Bauschinger (1832–93), the son of an artisan at Nuremberg, thrown on his own resources at the age of fourteen. Taught in the technical school, he became professor of physics and mathematics at Augsburg and Fürth, and afterwards of mechanics at Munich. He made one of the earliest researches on locomotives, in which indicator diagrams were taken when running. He established the first public laboratory, supported by Government, for testing materials, and introduced methods of accuracy not previously attempted, measuring extensions, for instance, to 1/250,000 of an inch. He first indicated the similarity of deformation in geometrically similar test-bars, and investigated the variation of the position of the elastic limit in overstrained bars. The "Mittheilungen," published under his direction, are a collection of extremely valuable and diversified researches.

It was due to Bauschinger's influence that an international association was formed in 1884 to discuss and standardise methods of testing.

Public Testing Laboratories.

In Germany, Austria, and Switzerland there are public laboratories, partly supported by the State, attached to technical high schools which are also Government institutions. Their function is to execute commissions for public departments or private persons. It was early recognised there that such laboratories can further industry and commerce, provided they meet the requirements of manufacturers, and at the same time are accepted as independent and impartial, and maintain a high standard of intelligence, accuracy, and skill. It is desirable that State institutions should carry out purely scientific investigations free of charge, but it is expected that private persons who use them should pay enough to cover outlay on special appliances or labour, while the cost of site, plant, and administration is borne by the State. It is possible for such institutions to follow out investigations suggested in the course of ordinary work which could not be attacked by private persons. In some cases industries have combined to have extensive researches, extending over years, made in these laboratories. The public make so much use of them that they are scarcely available any more for purposes of instruction. Thus in the engineering laboratory at Gross Lichterfelde there is a staff of 230 persons, of whom seventy-five have received high academic training, and thirty-eight others training in technical schools. The annual income from tests amounted in 1913 to 20,000*l.* and the expenditure to 32,000*l.*

The Bureau of Standards at Washington is a Government institution of the same type. It has four large laboratory buildings and four or five smaller buildings, which together cost 200,000*l.*, and the equipment about 70,000*l.* The annual cost of maintenance is about 120,000*l.* There is also an auxiliary laboratory at Pittsburgh. Of six departments one is devoted to tests of materials and structures. A great deal of work is carried out for public departments, and the Bureau settles the specifications of materials supplied to them, as well as inspects and tests them. I understood when at Washington that the testing of the immense quantity of cement used on the Panama Canal was confided to the Bureau, but much work has also been done for manufacturers' associations and scientific societies.

The National Physical Laboratory is very similar to the Bureau of Standards, and has accomplished for this country similar work. It has now become a Government institution, and the continuance of its very valuable work is assured.

[The remainder of the lecture was concerned with testing machines and tests carried out with them.]

[18] "Experimental Inquiry into the Tensile Strength and other Properties of Wrought-iron and Steel," by D. Kirkaldy, 1862.

[19] J. J. Guest, "Strength of Ductile Materials under Combined Stress," Proc. Physical Soc., vol. xvii.; Scoble, *Phil. Mag.*, 1906, vol. xii.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn from *Science* that at a meeting of the General Municipal Council and the Chamber of Commerce at Bordeaux on September 10 a proposal was unanimously adopted to establish, in honour of the President of the United States, a Franco-American University of applied sciences, commerce, and industry.

THE regulations for the current academic year for technical schools and other forms of provision for higher education in England and Wales have now been issued by the Board of Education (Cd. 9152). Substantially the regulations are the same as those in force since August 1, 1915. It is satisfactory to find that the Board is prepared to increase its grants in any cases in which it is satisfied that, as a result of general increases since the financial year 1913–14 in the rates of salary or fees paid to teachers, the grant so determined has become an inadequate contribution towards the cost of the schools or classes concerned.

AT a recent meeting of the governors of the Royal Technical College, Glasgow, it was announced that 2368*l.* has been added to the New Endowment (Research) Fund, making the total to July 31 last 21,245*l.* Since then the college has received a donation of 1000*l.* from Sir William Rowan Thomson, and a similar sum from Mr. James Templeton, so that the fund now nearly approaches 25,000*l.*, the sum in view when it was instituted. Mr. Francis Henderson has handed to the college a National War Bond for 1000*l.* as a donation to the fund. Sir George Beilby was re-appointed chairman of the governors, and Dr. Mackenzie vice-chairman. Lord Weir was elected to the vacancy in the board caused by the death of Dr. Dyer.

THE October issue of the *Scientific Monthly* contains some interesting particulars of the arrangements made in the United States to train students in colleges and universities for the Army. Since October 1 a students' corps has been in training in more than four hundred such institutions. At eight institutions in New York City about 20,000 men are in training, and if there are half as many in other institutions throughout the States, there must be 500,000 recruits from whom will be selected candidates for commissions and technical posts in the U.S. Army. The student-soldiers will be given military instruction under Army officers, and will be kept under observation and test to determine their qualifications as officer-candidates, and technical experts such as engineers, chemists, and doctors. After a certain period each man will be selected according to his performance and assigned to military duty. It cannot at present be stated definitely how long a particular student will remain at college, for this will depend on the requirements of the mobilisation and the age-group to which he belongs. The colleges are asked to devote the whole energy and educational power of the institution to the training desired by the Government.

IN moving the second reading of the School Teachers (Superannuation) Bill on Monday, Mr. Fisher, President of the Board of Education, said that the Government has come to the conclusion that it is essential at the earliest possible moment to bring under one State pension scheme all qualified teachers of aided schools of all kinds below those of university rank. The scheme of superannuation will be non-contributory. The terms upon which the benefits have been calculated closely resemble those of the Civil Service pension system. A teacher with an average salary of 400*l.* a year during the last five years of teaching service will, upon retirement at the age of sixty, receive a superannuation allowance of 200*l.* a year, and in addition a lump sum of 533*l.* No system of pensions for teachers can be regarded as satisfactory unless it provides for the free passage of teachers from one type of grant-aided school to another. The Bill places no obstacle in the way of such migration. Under the Bill no service in future will be pensionable except that which is rendered in grant-aided schools, with an exception in favour of those schools which come upon the grant list within the next five years. At present the pension scheme differentiates as against women, but in future the benefits to both men and women will be proportionate to their salaries. Mr. Fisher is confident that the Bill will achieve three objects of great educational importance: it will promote the unity of the teaching profession; it will improve the quality of the instruction given in the schools; and it will secure from the great developments which are bound to come under the operation of the new Education Act an army of men and women teachers who will be attracted to their calling, not merely by the material benefits which the measure will confer, but also by the knowledge that for the first time the State has given adequate recognition to the teaching profession. The cost additional to that of the present pensions scheme will be, in ten years' time, 2,000,000*l.* per annum, but the total cost will be about 2,428,000*l.*

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 23.—M. P. Painlevé in the chair.—A. **Lacroix**: A note by Dolomieu on the Lisbon basalts, addressed in 1779 to the Royal Academy of Sciences.—E. **Fournier**: Criterion of the forms of hulls favourable to the highest velocities.—P. **Vuillemin**: The principles of botanical classification.—G. **Scorza**: Ahelion functions with three independent variables.—G. **Sizes**: The tempered scale and its transformation into the modern chromatic scale.—L. **Daniel**: Action of a marine climate on the inflorescence of *Asphodelus luteus*. Cultivation of this plant on the sea-coast resulted in marked differences in behaviour of the flowers as compared with those grown inland.—L. **Léger** and G. **Mouriquand**: Anopheles and ancient malarial foci in the Alps.—J. **Bouchon**: Lymphatic bleeding as a means of disinfection of war-wounds. An account of a practical method for carrying out the lymphatic bleeding suggested in a recent note by Prof. Yves Delage.

September 30.—M. Léon Guignard in the chair.—P. **Appell**: An ordinary differential equation connected with certain systems of linear and homogeneous partial differential equations.—H. **Le Chatelier** and B. **Bogitch**: The heterogeneity of steel. Remarks on the macrographic as opposed to the micrographic study of steel structure. Six illustrations of the structures induced by melting electrolytic iron under varying conditions are given. The experiments show that the macrographic heterogeneity of steel is due to the presence of oxygen in solid solution in the iron.—P. **Vuillemin**: Classification of the dicotyledons.—E. **Cartan**: The varieties of Beltrami of three dimensions.—E. **Bauer**, P. **Weiss**, and A. **Picard**: The magnetisation coefficients of oxygen and nitric oxide and the theory of the magneton. Exact measurements of the magnetisation coefficients of oxygen and nitric oxide lead to results which are not in agreement with the magneton theory. Possible causes of the divergences are discussed.—H. **Pécheux**: The thermo-electricity of tungsten. Details of the change of resistance with temperature and thermo-electric power (against copper) of three drawn tungsten wires of unequal purity.—M. **de Chardonnet**: Sections of artificial silks. In the case of collodion silks it is possible from the section to distinguish between fibres formed by projecting the liquid into air or into water. In the latter case an estimate of the concentration of the liquid collodion employed is possible from the study of the section.—P. **Gaubert**: Isomorphous mixtures.—F. **Grandjean**: The interference fringes developed by friction and electricity in certain anisotropic liquids.—A. **Guébhard**: Remarks on the protosphere or primitive scoria shell of H. Douvillé.—H. **Béclère**: Anthropometric radiography of the thumb.—A. **Vernes**: Syphilimetric indices. Colorimetric determination of the deviations of stability.—MM. **Defressine** and H. **Violle**: The prophylaxy and treatment of influenza. Vaccination with an antipneumococcic serum is advocated, and, in the case of persons unavoidably exposed to infection, the use of a gauze mask.

October 7.—M. P. Painlevé in the chair.—J. **Boussinesq**: The theory of punching and the flow of plastic blocks: the elastic phase of these phenomena.—P. **Vuillemin**: The classification of dicotyledons.—G. A. **Boulenger**: The place of the Chelonians in classification.—J. K. **de Fériet**: Systems of partial differential equations verified by hyperspherical polynomials.—P. **Humbert**: Partial differential equations verified by Hermite polynomials, deduced from an exponential.—C. **Camichel**: Great velocities of water in pipes. The high pressures in current use in the hydraulic industry may give the water velocities of the order of 100 metres per second, but the experimental study of water velocities has not been taken above velocities of 10 metres per second. In the experiments described the velocities range from 80 to 0·09 metres per second. For velocities above 2·5 metres per second the relation $\log J = 1{\cdot}93 \log U - 0{\cdot}36$ was found to hold, where $J = \partial p/\partial x$ and U = the mean velocity.—A. **Véronnet**: The limit and extent of an atmosphere. Application to the planets.—M. **Portevin**: Internal strains developed in metals and alloys by rapid cooling.—H. **Béclère**: The construction of plans in stereoscopic radiography.—G. F. **Dollfus** and P. **Marty**: The discovery of a fossil-bearing layer in the Cantal.—P. **Georgevitch**: Asexual generation of *Padina pavonia*.—P. **Lesne**: The sub-fossil entomological fauna of the submarine peats of Belle Isle.

MELBOURNE.

Royal Society of Victoria, August 8.—Mr. F. Wisewould, vice-president, in the chair.—Miss N. C. B. **Allen** and Prof. T. H. **Laby**: The sensitiveness of photographic plates to X-rays. This work was performed in order to find the speed, inertia, contrast, and fog-density of various plates for exposures to X-rays, and the physical basis upon which these qualities depend. It was found that the density of a plate depends, within the range of wave-lengths investigated, not on the wave-length, but only on the energy of the X-rays.—F. **Chapman**: New or little-known Victorian fossils in the National Museum. Part xxii.: Some Palæozoic worms, with evidence of their soft parts. Trachyderma, one of the commonest fossils from the Silurian of the Melbourne area, has until lately been known only by sub-chitinous tubes penetrating the mudstone obliquely or vertically to the stratification. Recently discovered fossil remains, together with others collected many years ago, prove to be remarkably well perserved gill-plumes (prostomial appendages) of Trachyderma, which was a Chætopod having affinities with the Cryptocephala. Traces of eye-spots and dorsal appendices can be seen on some of the best-preserved examples. The tube of *Cornulites youngi*, a new species from the Lower Ordovician of the Moorabool River, is described. This is probably the oldest known species of the genus. The evidence of the present species points to an affinity with the worms, and by its blunt and impressed base was most likely attached to foreign bodies.

BOOKS RECEIVED.

All Alive O! A Vade Mecum for Breeders and Feeders of Horses, etc. By J. G. Lyall. Pp. 86. (Lincoln: Lyall and Sons.) 2*s*. 6*d*.

Société Française de Physique. Collection de Mémoires Relatifs à la Physique. Deuxième série. Les Progrès de la Physique Moléculaire. By Mme. P. Curie and others. Pp. 242+11 plates. (Paris: Gauthier-Villars et Cie.) 12 francs.

Biology of Sex for Parents and Teachers. By Dr. T. W. Galloway. Pp. 128. (London: D. C. Heath and Co.) 2*s*. net.

Fungi and Disease in Plants. By E. J. Butler. Pp. vi+547. (Calcutta and Simla: Thacker, Spink, and Co.)

Staple Trades and Industries. Edited by G. D. Knox. Vol. i. Wool. By F. Ormerod. Pp. xii+218. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

I Fenomeni Elettro-Atomici sotto l'Azione del Magnetismo. By Prof. A. Righi. Pp. xvi+435. (Bologna: N. Zanichelli.) 17.50 lire.

A Junior Course of Practical Zoology. By the late Prof. A. Milnes Marshall and Dr. C. H. Hurst. Eighth edition, revised by Prof. F. W. Gamble. Pp. xxxvi+515. (London: J. Murray.) 12*s*. net.

Numerical Trigonometry. By P. Abbott. Pp. x+163+mathematical tables pp. iii+33. (London: Longmans and Co.) 5*s*. net.

Mathematical Tables and Formulæ. By P. Abbott. Pp. iv+58. (London: Longmans and Co.) 2*s*.

The Future Citizen and his Mother. By Dr. C. Porter. Pp. xvi+144. (London: Constable and Co., Ltd.) 3*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 25.

PHYSICAL SOCIETY, at 5.—*Discussion*: The Case for a Ring Electron.

MONDAY, OCTOBER 28.

ROYAL SOCIETY OF ARTS, at 3.—Consideration of a Scheme for the Promotion of Industrial Art.

TUESDAY, OCTOBER 29.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Reginald A. Smith: (1) Stone Implements and "Tortoise-cores" Collected by Resident Magistrate F. J. Jansen at Victoria West, Cape of Good Hope; (2) Implements of Neolithic Types from Narkaru Bauchi Plateau, Nigeria, Exhibited by G. W. Lamplugh, F.G.S.; (3) Specimens of a Series of Stone Implements Collected by Capt. C. W. Cunnington, near Siwa, Libyan Desert.

TUESDAY, NOVEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Sir John A. F. Aspinall: Inaugural Address, and Presentation of the Medals recently Awarded by the Council.

WEDNESDAY, NOVEMBER 6.

SOCIETY OF PUBLIC ANALYSTS, at 5.—H. Droop Richmond: Note on the Graduation of Gerber Butyrometers.—B. G. McLellan and A. W. Knapp: The Estimation of Cacao Shell.

THURSDAY, NOVEMBER 7.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Tenth Kelvin Lecture—L. B. Atkinson: The Dynamical Theory of Electric Engines.

FRIDAY, NOVEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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NOTICE.

In consequence of the greatly increased cost of production it has been found necessary to raise the price of NATURE to 9d. The Subscription rates are now as follow:—

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THURSDAY, OCTOBER 31, 1918.

A HISTORY OF CHEMISTRY.

A History of Chemistry. By Prof. F. J. Moore. Pp. xiv+292. (New York: McGraw-Hill Book Co., Inc.; London: Hill Publishing Co., Ltd., 1918.) Price 12*s.* 6*d.* net.

IT is difficult to find excuses for a new "History of Chemistry" which starts from ancient times and brings the story down to the present day. All that can be usefully said about the alchemists and the early chemists before Lavoisier has been repeated many times in the various histories by Thomas Thomson, Kopp, Ernst von Meyer, Wurtz, Thorpe, and others, besides the innumerable special essays such as those of Thorpe and the Memorial Lectures of the Chemical Society. Teachers agree that the study of history in every department of thought is valuable to the student and indispensable to everyone who wishes to understand the present position and how it has been arrived at in each division of physical and natural science. It appears to the present writer that the process of tracing the evolution of ideas in science is most likely to be accomplished best by one who is contemporary with the discoveries which have led to advance and has taken part in discussions arising therefrom. One or two historians in every generation or about every thirty or forty years would be able to record correctly the progress which has been made in his own time. The history of science is not exactly comparable with the history of human affairs, which demands the lapse of a certain amount of time before a true valuation of events and movements becomes possible.

Every writer of a new book, however, doubtless assumes that his work has merits of its own, and it may be at once admitted that this is true of Prof. Moore's "History." But the preface which he has provided makes no reference to previous writers, and is worded as if he thought the task he had undertaken was entirely new. "The aim," he says, "has been to emphasise only those facts and influences which have contributed to make the science what it is to-day." The same claim in similar words has been put forward by many another writer on the same subject. Undoubtedly the book has some features of its own, and the last two chapters, which respectively trace the rise of physical chemistry and set forth, though briefly, the present state of knowledge of radioactive substances and the influence of such new knowledge on conceptions of the Atomic Theory, bring the story down to the present day.

The matter is rather severely compressed, for to include within the space of 271 octavo pages an account of chemical ideas from the times of the Greek philosophers down to the latest conclusions concerning the elements from X-ray spectra and atomic numbers implies a power of discrimination and concise expression, qualities which are not lacking in the author. The book is written in a brisk and lively style, and the personal biographical touches interpolated here and there ought to serve to whet the appetite for more and lead the student to make excursions into the literature usefully set forth at the end of each chapter. It has to be borne in mind that the lectures, of which the book is the outcome, were addressed to the senior students at the Massachusetts Institute of Technology, the concentration of the text rendering it much less suitable for readers not already familiar with the fundamental facts and principles of the science.

The author shows a sound judgment in setting forth the relative positions and merits of notable persons who figure in the history of the science and about which difference of opinion has been expressed in the past. "Little attention has been paid to questions of priority. A great discovery is usually preceded by a multitude of earlier observations. . . . From the historical standpoint the discoverer of a great truth is usually the one through whose efforts it first becomes available to the race." This remark in the preface is very just. It has always been acknowledged, for example, that oxygen was discovered by Priestley in 1774, and that the same element had been isolated from several sources by Scheele before that time, but the credit of publication belongs to Priestley. There was a tendency at one time in France to ignore Priestley, and in England to disparage the work of Lavoisier on the ground, by no means certain, that he did not "discover" oxygen independently of Priestley. Anyone who has read carefully the "Opuscules," which contain his observations on the calcination of metals and the consequent absorption of a portion of the air in contact, must perceive that this long course of experiment was undertaken with a definite purpose in view, and that the conclusions at which he arrived were independent of anything he may have heard from Priestley about his experiments on mercuric oxide.

The chapter on the periodic law again sets forth briefly all the earlier speculations concerning relations among atomic weights, and arrives at the conclusion that the principle of periodicity was discovered by Lothar Meyer at nearly the same time as and independently of Mendeléeff. Chap. xx., entitled "The Rise of Physical Chemistry," points out that this aspect of chemical science is not exclusively of modern origin. It began as soon as quantitative methods were established in all directions, and the foundations were laid by Lavoisier and Berthollet, and consolidated by the work of Gay-Lussac, Dulong and Petit, Regnault, Bunsen, Kopp, and others. The chapter gives evidence of the influence of Ostwald on the views of the author, who was among his pupils.

A word must be added about the illustrations with which the volume is abundantly supplied. They are all well meant, and many are interesting, but the portraits given are of very unequal merit, and some of them are, to speak frankly, quite bad—those of Mendeléeff and Fischer, for example. It may also be remarked that where the series of portraits is supposed to recall the founders of modern chemistry and the contributors of fundamental ideas one would expect to find the faces of Cannizzaro, Frankland, Raoult, Ramsay, Crookes, and perhaps several others whose services were at least equal to those of some of the chemists represented.

The book will be found useful by many students and by older chemists who may wish to refresh their memories of the origin and progress of ideas in the science to which they are devoted.

W. A. T.

ELECTRICAL BOOKS FOR STUDENTS.

(1) *Alternating-current Electrical Engineering.* By Philip Kemp. Pp. xi + 494. (London: Macmillan and Co., Ltd., 1918.) Price 17*s*. net.

(2) *Magnetism and Electricity for Home Study.* By H. E. Penrose. Pp. xxiii + 515. (London: The Wireless Press, Ltd., 1918.) Price 5*s*. net.

(1) IN his preface the author states that this text-book "covers in a general way the main ground included in the title without going into too great detail in any one particular branch." It is intended for engineers and students, and covers the syllabus for the Grade II. (A.C.) paper of the City and Guilds examination. So wide is the field covered that the book is almost an encyclopædia of alternating-current practice. The general reader, therefore, will be disappointed in places owing to the brevity of the descriptions and the lack of full explanations. In a book written mainly for examinational purposes there is not much room for original matter, but some of the proofs are neat and novel, and the author gives a new system of harmonic analysis which we discuss below.

To illustrate the danger of brief explanations, let us consider the definition of a condenser given on p. 50. This produces a blurred mental picture. "When two conducting bodies are separated by a dielectric they are said to possess *capacity*, and the combination is called a condenser." We are not told whether the conducting bodies are equal or not. When a difference of potential is applied we are told that one of the "plates" is positively, and the other negatively, charged. It is not stated definitely whether the positive charge is equal numerically to the negative charge, or what exactly is meant by the charge in a condenser. The descriptions of the Mansbridge and Moscicki condensers do not help the reader to clear up this point, and neither do the analogies given between a condenser and a gas globe, and between a condenser and a rubber diaphragm in a tube.

In the chapter on wave form several methods of harmonic analysis are given. In the first method Fourier's constants are determined by a simple but somewhat laborious evaluation of Fourier's integrals by mechanical quadrature. The method involves some very tedious calculations when high harmonics are required, but it is theoretically sound. In the author's method the assumption is made that the alternating wave can be expressed exactly by an equation of the form:—

$$e = E_1 \sin(\theta + \alpha_1) + E_3 \sin(3\theta + \alpha_3) + \ldots + E_{17} \sin(17\theta + \alpha_{17}).$$

It is then shown that by measuring eighteen ordinates of the positive half of the wave at the points 5, 15, 25, . . . 175 deg. respectively and proceeding in a perfectly regular and simple way we can determine all the values of $E_1, E_3, E_5, \ldots E_{17}$ and $\alpha_1, \alpha_3, \alpha_5, \ldots \alpha_{17}$. A schedule is given by filling up the blanks by which anyone can find these values without excessive labour. This solution is worthy of commendation, as it is much superior to that given by Runge, modifications of which are in everyday use. It has to be pointed out, however, that the author's solution is strictly only an interpolation formula. The Fourier constants are the constants we want in harmonic analysis, and it is highly probable that in most cases the higher harmonics determined in the author's way will only be rough approximations.

(2) In a series of fifty lessons the author discusses the elements of electricity and magnetism and also electrical engineering. We learn from the introduction that during the war he has given instruction in these subjects to a large number of recruits for the Royal Flying Corps, the Royal Navy, the Transport Service, and the Mercantile Marine. There is no doubt that the ordinary academical method of teaching the subject repels many, and so most teachers nowadays—especially those who are not cramped by an examinational syllabus—stimulate the enthusiasm of their pupils by making excursions into the imaginative realms of modern theory. For students of radio-telegraphy this practice is to be highly commended, as familiarity with these theories will be of real assistance when they have to work with valves and rectifiers. The drawback to introducing these theories at such an early stage is that it is bound in many cases to give rise to extraordinary misconceptions. To be told that a molecule must be regarded as a universe composed of several miniature solar systems stretches the imagination, but to accept it without proof and without any statement of its limitations is to expect the reader to adopt an altogether too passive attitude.

There are some strange errors in the book. We are told, for instance, that the existence of the æther is proved by the "lines of force surrounding a magnet in a vacuum" (p. 23). It is stated on p. 208 that the resistivity of a wire is not affected by increase of temperature, although the resistance is. We are also told (p. 303) that if we have two spheres, the surface of one of which is double that of the other, and if they be charged from the same source, then it is "fairly evident" that the charge on one will be double that of the other. Various deductions in capital letters are made from this, which preclude the suggestion that "surface" is a misprint for "radius." The writing is spirited in places, but the words are not always well chosen. There are other evidences of hasty writing. There is a large crop of errors in the appendix. Mass is defined as the density of unit volume! "The unit of force is that force which, acting for one second on a mass of one gram, produces an acceleration of one centimetre" (p. 500).

ELECTRO-PHYSIOLOGY.

Studies in Electro-physiology (Animal and Vegetable). By A. E. Baines. Pp. xxix+291. (London: G. Routledge and Sons, Ltd., 1918.) Price 12*s*. 6*d*. net.

THE author of this book was trained as a submarine-cable engineer, and many years ago, while engaged in cable testing, he observed an unexpected deflection of the galvanometer, which he finally traced to the disturbing electrical action of his own body. An interest in electrophysiology was thus aroused, and he was led to undertake a series of experiments which, in his own words, "convinced me that a force resembling electricity, if not identical with it, was constantly generated in the body." He followed this up by making numerous observations on plants and on the human body in health and disease, and this book is the result.

Unfortunately, the author has had no training in biology, and he altogether fails to realise the difficulty of making advances in any field of scientific work without a good knowledge of general principles and of the results attained by previous workers. His attempts to acquaint himself with the literature of the subject have certainly, in some directions at least, been unfortunate. Using as a basis first a quotation from a text-book of botany which was out of date many decades ago, then a paragraph from Sachs's well-known work published in 1882, and, finally, the absence of any reference to the subject in a more recent *elementary* text-book, he arrives at the conclusion that there have been practically no observations on "vegetable electro-physiology." Had the author no plant physiologist among his acquaintances who could have referred him to the works of Jost and of Pfeffer? In Pfeffer's work he would have found a *résumé* of the subject, and he would have realised that there was nothing new in the observations which he made in the year 1900 of the electric current to be obtained from an apple. That a difference of potential exists between different organs of the same plant and between different parts of the same organ and even of the same cell has been known for a long time.

The author is sadly led away by analogy of the crudest description. The book is dedicated to the medical profession, but the extraordinary comparison of animal and vegetable structures shown on pp. 120–26 will scarcely appeal to its members. One finds a ganglion-cell compared with a germinating spore of Vaucheria, a transverse section of a spinal cord compared with a bean root, a transverse section of a sciatic nerve compared with a single parenchyma-cell from a bean seed, and a muscular fibre compared with a sclerenchyma-fibre. These comparisons are supposed to indicate "the universality of the law which governs all things," but it is not quite clear what that law is.

In the latter part of the book the author attempts to explain the structure of muscle, of nerve, of the eye, etc., on a purely electrical theory in which hypothesis and analogy appear to play the main part. In dealing with the eye the possibility of photochemical action is not mentioned. In the theory of muscular action put forward, the contraction is supposed to be due to the attraction between plates in the sarcomeres, the plates being alternately charged and discharged as a result of the current passing through the motor nerves. In this theory, which scarcely seems electrically sound, the source of the energy required for contraction lies outside the muscle, apparently in the brain or spinal cord. In these circumstances it is difficult to see how even the most sedentary of us escapes "brain fever." The author refers the paucity of results attained by physiologists in this special field of work to the fact that "these great men . . . were not, any of them, trained submarine-cable electricians." He apparently fails to realise that—since the problem is a "border-line" one—such a suggestion lays him open to a very obvious retort. V. H. B.

OUR BOOKSHELF.

The War and the Coming Peace: the Moral Issue. By Prof. Morris Jastrow, jun. Pp. 144. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 5*s*. net.

A WAR that involves almost four-fifths of the entire world must surely have issues deeper than race-antagonisms, conflicting national ideals, and commercial rivalries. According to Prof. Jastrow, the fundamental issue is moral—"the recognition on the part of the world that an attempt to carry out national policies through the appeal to force, or even by threat of force, is a cardinal sin against the moral conscience of mankind." In practice and even in profession Germany stands for the "might is right" doctrine, but civilisation has increasingly meant the replacement of physical power by factors of a higher order. "Civilisation means the gradual elimination of mere brute force as the weapon to carry out man's destiny." Taking a rather one-sided and traditional view of Nature's strategy, the author sees an inherent contrast between it and the conscious direction of civilisation, and as a modern Zoroastrian he hears in the rattling of the sabre the voice of Ahriman. He gives powerful and solemn warning against the sin, which is not confined to Germany, of employing the power of Ahriman to bring about the triumph of Ahuramazda. He hopes that the liberal and wholesome elements in Germany may eventually save Germany from the domination of a militarist group and false ideals. The primary condition of a peace which is more than an armistice must be found in a democratic form of government. The subsequent steps will be arbitration tribunals, disarmament, and an international parliament. These seem far enough off at present, but it is important to make up our minds whether we really desire them, and if not, why not. Prof. Jastrow's wisely written book—careful and restrained throughout—makes for illumination.

The Strategic Geography of the Great Powers. (Based on a Lecture delivered during 1917 to Officers of the Grand Fleet and of the British Armies in France.) By Dr. Vaughan Cornish. Pp. viii+114. (London: George Philip and Son, Ltd., 1918.) 2*s.* net.

WITHIN the compass of a small volume Dr. Vaughan Cornish has tried, not unsuccessfully, to crowd many ideas. He describes the great States of the world as regards their sources of men and materials, and the lines of communication by which force can be concentrated. His point of view is often fresh and always geographical. The distribution of the British Empire is described, not by continents, but by oceans. The old system merely emphasises the gaps in continuity of the Empire. Dr. Cornish's method indicates an appreciation of the ocean as a highway linking together the component parts of the Empire. But land routes may also be of importance. In his treatment of Asia Dr. Cornish insists on the strategic value of southern Turkestan and northern Afghanistan as the eventual crossing-place of the chief lines of traffic from Moscow to Delhi, and from Constantinople, Cairo, and Bagdad to Pekin.

The volume has small coloured maps of Europe, Asia, and the world. The last, on a Mercator projection, would have been a better illustration of the chapters if it had been on an equal-area projection. Dr. Cornish's work is an excellent introduction to the geographical conditions of national security, and should be widely read.

B.S.A. Musketry Score Book for Use in the General Musketry Course. Instructions for Short Lee-Enfield Rifle and Enfield Pattern 1914 Rifle, Using Mark VII. Ammunition. By E. J. Smyth. Pp. 47. (London: Forster Groom and Co., Ltd., 1918.) Price 3*d.* net.

THIS excellent little book is a combination of a book of instruction and a score record. It contains clear instructions for the sighting to be employed at higher ranges after making a group at 100 yds., so that the error of the rifle may be obtained without the long experience with the individual rifle which is desirable but cannot always be obtained. The instructions for the short Lee-Enfield rifle and for the Enfield pattern 1914 are placed together, but are indicated by distinctive borders so that no confusion can arise. The book should prove particularly useful to every Volunteer in order to enable him to know the behaviour of his own rifle on the completion of his musketry course. It is also a most useful guide to the course itself.

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 Perception of Sound.

As I had the privilege of being consulted by Sir Thomas Wrightson during the later years of his "Inquiry into the Analytical Mechanism of the Internal Ear," and advising him as regards the physical nature of the cochlea and the arrangement of its parts, I may be allowed to try to clear up the various objections formulated by Prof. Bayliss (NATURE, October 17, p. 124), as they chiefly concern matters relating to anatomy or physiology. When Prof. Bayliss looks again at the title of Sir Thomas Wrightson's work, which I have quoted above, he will see that he is in error in supposing that the Wrightson theory deprives the cochlea of the analytical function postulated by Helmholtz. Helmholtz's theory presupposes that the cochlea contains an extensive series of resonators for resolving a sound complex into its component waves; Sir Thomas Wrightson's theory presupposes that the cochlea is a machine designed for the purpose of analysing sound complexes and of registering its component waves as nerve impulses. I fear it is a loose statement of mine on p. 159 of the Appendix to Sir Thomas Wrightson's book that has misled Prof. Bayliss; there I have written that "the *final* analysis must be done in the cortex of the brain even if Helmholtz's theory is true." That I still believe to be the case.

Prof. Bayliss demurs to the opinion I have expressed that no theory of the mechanism of the ear can be regarded as satisfactory that fails to explain the form and the arrangement of its various parts. I have found that to be an absolutely infallible law as regards every part of the animal body concerned in movement. In every bone, joint, muscle, tendon, and ligament which has been investigated the result has been the same—the material of which each is made has been found to be so placed, so shaped, and so arranged as to carry out the particular function which has been assigned to it. Whether we accept Helmholtz's explanation of the mechanism of the internal ear or Sir Thomas Wrightson's, we are dealing with a machine concerned in movement, and it is, therefore, legitimate to infer that its parts are designed to subserve its various movements. The only structural feature of the cochlea explained by Helmholtz's theory is the gradual increase of the basilar membrane from its proximal or fenestral end to its distal or helicotremal end. The elaborate structure of the organ of Corti and the conformation of the canals of the cochlea are left unexplained, whereas in Sir Thomas Wrightson's theory all these matters receive a rational explanation. On the Helmholtz theory we must believe that the rabbit is provided with a more delicate analytical machine than man, and the sloth with a more elaborate one than the most tuneful bird. Nay, we are certain that if Helmholtz's explanation had been the right one, Nature could have secured the necessary mechanism in a much simpler way, namely, by providing the auditory hair-cells with processes or cilia of the requisite qualities and dimensions to serve as sympathetic resonators.

I now come to a very important and very difficult objection that has been raised by Prof. Bayliss. Sir Thomas Wrightson's theory certainly presumes that the fibres of the nerve of hearing are capable of carrying

5000, 20,000, 40,000, or more impulses per second. He rightly says we have no experimental evidence that a nerve can convey at the utmost more than 500 impulses per second. He quotes the investigations of the late Dr. Keith Lucas, but Keith Lucas was careful to point out ("The Conduction of the Nerve Impulse") that his work had been necessarily confined to the motor nerves of muscles, and was clearly of the opinion that his results were not transferable to sensory nerves, "particularly in the case of light and sound." Indeed, on Helmholtz's theory we infer, and are justified in the inference, that certain fibres of the auditory nerve must be capable of carrying at least 18,000 impulses per second—if we accept that number as the upper limit of our range of hearing. In Sir Thomas Wrightson's theory it is necessary to presume that every hair-cell is capable of generating, and every auditory fibre of conducting, at a rate which may vary from 60 per second to 80,000 per second. I anticipate that the internal ear will provide psychologists with the most delicate means of investigating the manner in which sensory stimuli are produced by mechanical means.

Instead of Helmholtz's theory being in conformity with Müller's law, and Sir Thomas Wrightson's at variance with it, I am of opinion that the opposite is the case. In consequence of having adopted the theory of resonators, Helmholtz had to make the further assumption that the auditory differed from every other sensory nerve—such as those of touch, taste, and smell—in that its fibres were specialised into 15,000 or more units or groups, whereas in ordinary sensory nerves there is no such specialisation, every one of its fibres being capable of serving the same kind of function. The only exception is the optic nerve, in which Young and Helmholtz postulated at least three kinds of units or fibres. The recent investigations of Dr. F. W. Edridge-Green and of Dr. R. A. Houston tend to prove that there is no need to postulate a functional differentiation in the fibres of the optic nerve, and similarly the Wrightson theory does away with the necessity for presuming that the auditory nerve contains 15,000 sets of fibres which are functionally distinct.

No reference was made by Sir Thomas Wrightson to experiments which had demonstrated that animals subjected to a prolonged repetition of a note of a high vibrational frequency suffer a degeneration at the narrow, proximal or fenestral end of the organ of Corti—just the area which we may presume would be affected if the theory of Helmholtz were true. Nor was allusion made to the less certain results obtained at the opposite end of the organ by prolonged repetition of notes of low frequency. From the measurements and data which I placed before Sir Thomas Wrightson, he estimates that in all stapedial movements pressure falls simultaneously and equally on all parts of the basilar membrane, but of this I am not convinced, conceiving that notes of high frequency, especially where the waves rise sharply to their maximum intensity, will fall chiefly on the proximal or narrow end of the basilar membrane, whereas notes of low frequency, rising slowly to their maxima, will fall chiefly on the distal or wide end of the membrane. If such is the case, then it is not necessary to invoke Helmholtz's theory for their explanation. The explanation is not a new one, having been put forward by Prof. Max Meyer, of the University of Missouri, a number of years ago.

There are also the cases observed by aural surgeons where tone-gaps or islands occur in the gamut of hearing. These cases receive an apparent explanation on the Helmholtz theory. I think it will be found that such cases represent defects in the auditory system corresponding with colour-blindness in the visual system, both representing disorders, not in the peripheral, but in the central, parts of the auditory and visual systems. I would direct particular attention to a statement made by the late Keith Lucas on the last page (p. 102) of his posthumous work on "The Conduction of the Nervous Impulse":—"*On the basis of this analysis we have pictured the central nervous system as a network of conductors having different refractory periods, communicating through regions of decrement, easily fatigued.*" A network of conductors having different refractory periods presents the exact mechanism needed for the sorting out of the millions of impulses which reach the auditory centres along the fibres of the auditory nerve. Sir Thomas Wrightson has shown that, however complex the sound, each component part is registered by the hair-cells as the complex passes through the inner ear. Keith Lucas's speculations open up the possibility of a central machine for assorting the impulses according to their time-intervals.

I, for one, am particularly glad that Prof. Bayliss has taken an interest in this matter, because his knowledge of that borderland which lies between physics and physiology peculiarly fits him to adjudicate on the claims of the Helmholtz and of the Wrightson theories of the internal ear. A. Keith.

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Epidemic Influenza.

Prof. Hewlett's interesting article in Nature for October 24 may justify the statement of a few facts collected during the last quarter of a century. Dealing with the Registrar-General's returns for London and considering twenty deaths per week as epidemic if this number or more is maintained for successive weeks, there have been twenty-eight epidemics since the reassertion of the complaint in 1890. Of these there have only been two, in the years 1910 and 1911, with fewer deaths than 100. The only years in the epoch without influenza being epidemic are 1896 and 1901. The most serious epidemics since 1890 occurred in 1891, 1892, and 1899–1900, in each of which there were in London upwards of 2000 deaths. In recent years the most serious epidemic occurred in 1908 with a total of 1061 deaths, but the summer and autumn epidemics of the present year bid fair to be at least as severe.

The two epidemics of the present year differ very materially from all the other epidemics since 1890 with respect to the age-death. The Registrar-General has introduced a slight change in the returns from 1911, which prevents 40 being uniformly adopted as an age-limit for death. Taking all the epidemics from 1890 to 1916–17, the deaths at ages from 0 to 20 years were 12 per cent. of the total number; from 20 to 40 or 45 years, 14 per cent.; and from 40 or 45 years and upwards 74 per cent. These numbers are remarkably similar in the several epidemics. For the two epidemics this year the deaths for the respective ages are 0 to 20 years, 26 per cent.; 20 to 45 years, 48 per cent.; and above 45 years, 26 per cent. It is an interesting problem to account for the difference introduced in the ages of death in the epidemics of the present year.

Prof. Hewlett refers to the disease waning and almost disappearing after the epidemic of 1893–94, but an examination of the Registrar-General's returns will show that the epidemics were exceptionally severe in 1895, 1899, and 1899–1900, and also in 1908, the deaths in London from influenza alone exceeding

1000 in each of these attacks. The year 1891 is referred to as the worst period, but at the date mentioned the Registrar-General says "one death was primarily attributed to influenza." In lieu of 1891 the year 1892 should have been given, when for the week ending January 23 the deaths in London were 506. The quiescence of the disease lasting three-and-twenty years is scarcely tenable, as shown by the above facts.

The total number of deaths from influenza for the past summer epidemic was 929 (not 1600), based on the reasoning followed in all epidemics since 1890. In the attack now in progress the total deaths (371) in London for the week ending October 19 were more than in any epidemic since 1895, when the deaths in the week ending March 19 were 473.

Since 1890 no influenza epidemic has occurred in London in September, only one (the present year) in August, two in October, two in July, three in June, and four in November. Of the total twenty-eight epidemics twenty-four have occurred in March and twenty-one in February.

Although the weather seems to have little bearing on the disease, the temperature generally has been abnormally high and the air humid at the outbreak of several of the epidemics, whilst when the air becomes cold and dry the incidence of the disease is commonly reduced.

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Supplies of Amœba proteus for Laboratories.

ONE of the ways in which the war has interfered with zoological teaching in this country is by cutting off supplies of various of the animal types which are examined by the student in the laboratory. Amongst these, as has already been indicated by letters to NATURE, is Amœba—the animal with the study of which many zoological courses commence.

It is easy enough to obtain Amœbæ of a kind, but what the teacher requires is a supply of the large Amœba which commonly goes under the name *A. proteus*. Of this, again, it is easy enough to obtain a few specimens, but the teacher—at least, if he has a class of nearly four hundred students, as is the case in this University—must be able to obtain a thousand or more specimens on a particular date.

With the object of grappling with our local difficulties in this matter, Dr. Monica Taylor, S.N.D., has been so good as to make a special study of the distribution of *A. proteus* in the neighbourhood of Glasgow, and of its culture in the laboratory. Pending the publication of her paper on the subject, I think it may be useful to other teachers of zoology if I summarise in a few words her chief results.

During the months June to December *A. proteus* seems to be of general occurrence in moorland lakes and ponds, while it disappears from December to May—no doubt becoming encysted, as described by Miss L. Carter (Proc. Roy. Phys. Soc. Edin., vol. xix., 1915). The main conditioning factors of its occurrence appear to be abundant food supply and a rich supply of oxygen. An apparently ideal spot is one where richly oxygenated water from the overflow of a pond passes over mud rich in organic *débris*.

The supplies of Amœba obtained in such a locality are placed in aquaria in which the water is richly aerated either by water-weed or by a special apparatus, and as a source of food supply grains of wheat are mixed with the mud, as suggested by Hyman. In this way Dr. Taylor has succeeded, as she says, in obtaining "millions" of Amœbæ in laboratory cultures.

J. GRAHAM KERR.

University of Glasgow, October 2

ALCOHOL IN INDUSTRY.

NOT the least remarkable result of the war on this country will be its effect on the development of chemical industry, and especially in the application of organic chemistry to the chemical arts. This, of course, has primarily resulted from the cutting off of the large supplies of manufactured organic products—mainly synthetic dyes and drugs, photographic chemicals, and numerous other substances comprehended under the term "fine chemicals"—which prior to 1914 mainly came to us from Germany. Thrown thus upon our own resources, we were compelled, in the interests of national health and welfare, to attempt the manufacture of certain of the more important of these products. Great difficulties were experienced at the outset, owing to our lack of experience and the absence of skilled assistance. The supply of chemists with any real training in the application of organic chemistry to industry was very far short of the sudden demand. We were overtaken by a Nemesis invoked by our own inactivity and lack of foresight. It is only within recent years that the teaching of organic chemistry has received any considerable amount of attention in our universities and technical colleges. For the most part it has been regarded as a purely academic subject, to be studied in the interests of pure science, and with no thought to its technical application as a branch of manufacturing chemistry. Except to the few who sought to fit themselves for a career in science, mainly as teachers, there was little or no inducement to pursue its study, as there were very few opportunities in this country to turn a knowledge of it to practical account.

The situation at the outbreak of war was further aggravated by the action of the Army authorities in drafting such trained men as were available into the combatant ranks. But, notwithstanding these disadvantageous circumstances, an astonishing amount of progress has been made. As regards medicaments our manufacturers have risen to the demands made upon them. In spite of many setbacks due to inexperience and ignorance, and the lack of adequate plant, we have it on the testimony of the highest authorities that the Services are now adequately supplied with every needful drug. In this respect our men, and the country generally, are infinitely better off than our enemies. It is notorious that Germany, in spite of all her boasted power of organisation, has failed lamentably in meeting the necessities of her Medical Service, and an untold amount of suffering, permanent injury, and a greatly increased mortality have thereby resulted.

As regards synthetic dyes, if the progress has not been relatively so striking or so adequate as in the case of drugs, it has at least been very considerable. We are very far from being alongside Germany yet, either in the amount or the range of our output, but we are in a fair way of being able to meet our more urgent demands. It is impossible in five years to make up the leeway of fifty, especially of fifty years of strenuous and almost feverish activity. With the blessed prospect of peace now in sight, it is hopeless to expect that we shall wholly catch up our rivals. Indeed, it will require skilful handling, both on the part of the Government and of our manufacturers, to safeguard the position we have already won.

But whatever the future may have in store, it is quite certain that applied organic chemistry in this country has received a great impetus, and that it is destined to become an increasingly important factor in our chemical industry. In certain subordinate branches, indeed, the ground gained has already been consolidated. German competition in the case of some organic products is no longer in question. Not only have we succeeded in manufacturing these substances; we are also turning them out of better quality than heretofore and rapidly securing a world-wide market for them.

In view of the prospect before us the problem of the supply of alcohol for industrial purposes acquires a fresh importance. It has been in the past a somewhat thorny question, made needlessly acute by misunderstanding and misrepresentation. It has been complicated by fiscal considerations, and by the attitude of a Treasury which was more concerned in safeguarding and securing revenue from this source than in appreciating the demands of industry. The Treasury, although ultimately responsible, may plead that it is not wholly to blame, since in this matter it is dependent upon its official advisers, who, being for the most part persons attached to revenue departments, could not be assumed to be altogether unbiased. Still, in spite of official inertia and conservatism, the revenue authorities have, of late years, become increasingly sympathetic with the needs of manufacturers, and concessions and relaxations which twenty years ago would not have been contemplated are now readily obtainable. A stumbling-block is the necessity for denaturing. Wood-naphtha costs more than ordinary spirit, hence methylated spirit is more expensive than duty-free common alcohol. In some cases the presence of methyl alcohol, or the substances associated with it in the crude commercial article, are positively detrimental. The Excise authorities have appreciated these objections by allowing manufacturers to denature the alcohol by the use of some substance which is ancillary to the manufacture of the article for which the alcohol is needed, and at the same time renders the spirit unpotable.

It can scarcely be doubted that industry will need much larger quantities of alcohol than have hitherto been available, and increased attention will need to be paid to possible sources of supply. It is not only in industrial chemistry and in many other arts that alcohol is required. It is beginning to receive consideration in this country as fuel, and particularly in internal-combustion engines. Up to the present time the use of alcohol as motor fuel with us has not been a commercial possibility; it could not be produced at a price that would compete with petrol at pre-war figures. Circumstances have, however, changed, and it is unlikely that any form of motor-spirit will sink, at all events for some time to come, to the prices of 1914. Nor is it probable that the raw materials which have hitherto served for the manufacture of alcohol in this country will for years reach their former low values. These substances for the most part have been cereals, or some form of starch-producing, and therefore potential sugar-producing, material. In addition, considerable quantities of spirit have been made from molasses and other saccharine substances capable of fermentation. Potatoes with us are too valuable as a food to be employed, as in Germany, for the manufacture of alcohol.

But there are other modes of obtaining alcohol than from substances which can be used for food, and it is this circumstance that has induced Mr. Long to appoint the Committee to which we made reference in NATURE for October 17. Large quantities of spirit are now obtained from the sulphite liquors in the manufacture of wood-pulp, and factories for the manufacture of alcohol by this process have been established in Sweden, North Germany, America, and elsewhere. To such an extent has the manufacture developed in Sweden that the Government is contemplating a monopoly of the wholesale trade in technical spirit—a measure which has aroused considerable opposition in industrial circles. We learn that a company with a minimum capital of 1,000,000 kronor has been founded in Stockholm to manufacture and sell motors and automobiles run on sulphite spirit.

The process of treating seaweed, to which Sir Edward Thorpe directed attention in a recent letter to the *Times*, is a method of saccharifying cellulose material very similar in principle to that employed in the wood-pulp industry. Factories to exploit seaweed in Sweden have been or are being erected at Varberg and in Skane, probably on lines similar to those worked in Glasgow. Considering the enormous quantities of valuable seaweeds to be met with on our coasts, especially among the Western Isles of Scotland and on the west coast of Ireland, it is to be regretted that no effective steps are taken to turn them to practical account. Although formerly of considerable commercial value, the only use that is now made of them is to a limited extent as manure on land adjacent to the shores on which they are gathered. Only an infinitesimal amount of that readily available is so used, and it seems a pity that material so intrinsically valuable should not be dealt with more efficiently.

EPIDEMIC CATARRHS AND INFLUENZA.

THE present epidemic of influenza, and the rise in the rate of mortality consequent upon it, are receiving much attention in the public Press, and many irresponsible statements are being made concerning the disease. Among these is the hint that the "so-called influenza" is plague in a thin disguise. These erroneous views may at once be discounted. There is no doubt, as Prof. Hewlett stated in his article in last week's NATURE, that in the present outbreak we are concerned with the same disease which was widely pandemic in 1889–92, and prior to that had been almost unknown for forty-three years. Since 1892 influenza has lifted up its head at intervals of a few years, and since war began it has been the cause of a fairly heavy mortality in this country, as well as among other belligerent nations, and farther afield in South Africa, in India, and in various parts of America. A clear general conspectus of our present knowledge, and, it may be added, our lack of knowledge, of the disease is given in a memorandum[1] recently issued by the Medical Officer of the Local Government Board.

The chief peculiarity of the epidemic prevalence of influenza during 1918 is that it has occurred at short intervals, scarcely three months having intervened between the epidemic which culminated in July and the even more severe epidemic which now prevails throughout the United Kingdom, and is almost world-wide. It has recently been stated that the epidemic occurrence of influenza in July should have furnished warning of the present autumnal epidemic. Those who put forward this statement have not made themselves acquainted with our national experience of influenza. In actual fact no previous known epidemic of influenza in this country has had a summer maximum, and no previous epidemic has recurred within three months of a previous epidemic. In the light of events this rapid recurrence is not difficult to explain; for the exigencies of warfare, the rapid transport of many tens and hundreds of thousands of troops across the seas in circumstances which necessitated dense aggregation of persons, have intensified infection, multiplied the opportunities for severe secondary infections, and have exposed the civil population to exceptionally virulent complex infection.

The memorandum referred to above states that the bacillus of influenza (Pfeiffer bacillus), which commonly is present in these cases—whether causally or as an aggravating cause of pneumonia—has associated with it pneumococci and hæmolytic streptococci, which produce septic pneumonia and empyema in a considerable proportion of the total cases. The question of vaccine treatment and of prophylaxis by vaccine is considered, and there is some hope of success in this direction, though reliance must be placed chiefly on the hygienic precautions which are detailed in the official document. Of these, probably chief importance should be attached to the avoidance, so far as practicable, of overcrowded conditions; and in this connection special stress is laid on the importance of avoiding large units of aggregation, which greatly intensify the risk of infection. The importance of this consideration is too often ignored in civilian life; under military conditions such large units of aggregation cannot always be avoided.

The main object of this article, however, is to emphasise the need for further research on this disease. Some of the lines on which such research is called for are indicated in Sir Arthur Newsholme's memorandum. "Influenza is to be regarded as a member of a group of catarrhal infectious diseases which in the aggregate are perhaps the chief enemies of human health," and it is significant that even in the years when the ravages of influenza are greatest bronchitis and pneumonia are each responsible for twice as many deaths as influenza. Thus the general problem is that of the prevention of catarrhs. How can immunity be secured and maintained? Will immunity against one catarrh-causing organism assist in securing immunity against others? If immunity cannot be secured against influenza, can one rob the disease of its terrors by a vaccine against purulent bronchitis or pneumonia?

These are among the problems urgently needing investigation. When the National Insurance Act was passed, one of its most valuable provisions was the 1*d*. per insured person which enabled the work of the Medical Research Committee to be initiated. During the war the energies of this Committee, and, it may be added, of most pathologists who could have been utilised for a national investigation on influenza, have been diverted to war-work. This work has been of great value; but it may be hoped that ere long staff and time will be available for a steady and continuous investigation of the numerous problems of immunity in relation to catarrhal infections. The public must be prepared to spend money on such investigations on a much larger scale than in the past if success is to be achieved; and for this purpose it will be necessary to train a generation of pathologists who can be certain of a fair livelihood while undertaking such work. Unless careers as pathologists are open to a much larger number of specially qualified workers than are at present available, the work of research will continue to be hampered as in the past. The harvest truly is great, but the labourers are few.

Meanwhile we must depend in the main on avoidance of crowds and on the practice of elementary personal hygiene in the prevention of influenza. The public can minimise this disease only by the active co-operation of every member. This involves a self-abnegation on the part of persons suffering from catarrh which is too often absent; they consider their work as more important than the welfare of their co-workers; and it is evident that so long as this continues influenza will at intervals continue to plague humanity.

DYESTUFFS AND THE TEXTILE INDUSTRY.

NOTHING could be more convincing of the neglect of this country to provide the means whereby the applications of scientific discovery should be made available in the conduct of important industries than the speech of Mr. Lennox B. Lee on the occasion of the annual meeting of

[1] Memorandum on Epidemic Catarrhs and Influenza. By Sir A. Newsholme, K.C.B. (H.M. Stationery Office.) P

the Calico Printers' Association, of which he is chairman, on September 18. It appears that the association is by far the largest user of colour in this country. Before the advent of the war the 2000 colours it then used were to the extent of 70 per cent. produced solely in Germany, and of the remainder only 7 per cent. were of British origin. At the present time out of the restricted list of 230 essential base colours only 25 per cent. are produced by British makers, one-third of these being substitutes, and only used because better colours cannot be obtained, whilst the cost is not less than from 200 to 1000 per cent. above pre-war prices. Moreover, of the 230 colours above-named, only the commoner colours, including also one or two of the better kind, are obtained from British firms. The association is, in fact, dependent upon the Swiss colour manufacturers for the finer ranges and specialities, while quite half the colours of the said list cannot be obtained at all, amongst them some of the most valuable.

This is a very serious state of affairs, since of the cotton goods export of Great Britain, amounting in 1913 to 56,000,000*l.*, more than half were exported in the coloured state. Unless in the future the colours essential to the industry can be produced in this country of a quality and range and at a price which compare favourably with the production of Germany and Switzerland, this great industry must inevitably suffer, and be doomed to ultimate failure; and not alone this important moiety of our cotton textile exports, for we shall likewise imperil the market for uncoloured textiles also. A boycott which is contemplated on the import of German dyes, with the view of encouraging the production of British dyes, will not meet the case so long as the quality or the class of dye (new dyes are continually being produced), or the price at which they can be sold to the user, will not compare with the product of the foreign manufacturer. The calico printers and dyers, having regard to the fact that they are in competition with nations all over the world in foreign markets, must of necessity get the colours they require in the best and cheapest market, and if they cannot procure these at home must do so where they can. We have the raw material of the coal-tar colours here in vast quantities, which we largely exported to Germany, and in the case of one large firm in the North of England, which is Swiss-owned, the intermediate products are sent to Switzerland, to be there treated and returned to this country in the form of dyes of fine quality.

There is but one effective remedy for this most serious menace to one of the greatest of our industries, and it consists in the provision of a numerous highly trained body of skilled workers which it is the business of our scientific colleges to supply. Therein lies the initial advantage of Germany and Switzerland. Just fifty-six years ago it was confidently stated in an official document that, having regard to the exhibits at the International Exhibition, London, in 1862, "England has now become the dye-producing nation of Europe," and we now see, because of our lack of enterprise and vision, how completely this has been falsified. Mr. Milton Clarke, the president of the Bradford Dyers' Association, declared in February, 1916, that the establishment of the synthetic dye industry was vital to our national safety, since dyes and high explosives were very closely related, and that complete, self-contained, and independent manufacture of aniline dyes within the United Kingdom was essential to the commercial and martial protection of the State. "Had it not been for the aid we have received from the Swiss makers," he went on to say, "I dare not contemplate what our position would have been during the last eighteen months."

The vital importance of this question is evidenced by the fact that, taking the whole range of the textile industries of the kingdom, the annual exports reach a total value of 200,000,000*l.*, and the number of persons employed is something near two millions. It is, therefore, a matter of serious national concern, and justifies the Government in any prudently considered action which would legitimately and permanently ensure the well-being not only of the dye-producers, but also of the dye-consumers. Wisely conceived, their interests are mutual and inseparable, and must be studied as a whole.

THE RIGHT HON. SIR EDWARD FRY, G.C.B., F.R.S.

SIR EDWARD FRY, who died on October 18, within a few weeks of reaching the age of ninety-one, was born at Bristol, and educated at University College, London. He was called to the Bar in 1854, and, after a brilliant career, was made a Lord Justice of Appeal in 1883. He resigned in 1892, but his services were repeatedly utilised by the Government, particularly as chairman of various Commissions. He was also a member of the Hague Permanent Arbitration Court. A man of wide knowledge and interests, he was a good classical scholar and a student of history, philosophy, and the natural sciences. As a boy he and his younger brother David took a keen interest in the flora of the district near their home in Bristol, an area which included the famous botanical locality, the St. Vincent's Rocks. Mr. David Fry, who died in 1912, was a fellow-worker of Mr. James White, author of the Bristol "Flora."

Sir Edward Fry was especially interested in mosses, and a lecture which he gave in 1891 at the Royal Institution on British mosses was developed into an admirable little text-book in which the life-history, structure, and phylogeny of the mosses are described in a popular but thoroughly scientific manner. A second edition appeared in 1908. A companion volume on the "Liverworts, British and Foreign," appeared in 1911. In the latter work Sir Edward Fry was assisted by his daughter, Miss Agnes Fry, who had also been his collaborator in a somewhat similar booklet on the Mycetozoa, published in 1899. The last-named no doubt was the outcome of Sir Edward Fry's friendship with the late Mr. Arthur Lister and Miss G. Lister, the results of whose work on this remarkably primitive and isolated group of organisms had recently been published in the British Museum Catalogue of the Mycetozoa.

Sir Edward Fry's interest was not confined to the lower plants. One who met him in Switzerland recalls his knowledge of the Alpine flora; and in reference to a trip which he made with the Listers to Egypt in 1900 Miss Lister writes: "I well recall his deep interest in the xerophytic desert plants. The collection was worked out at home with the aid of Boissier's 'Flora Orientalis,' and took its place with those from Greece and other foreign and homelands he had visited." In the garden of his home at Failand, near Bristol, he had brought together many rare and unusual plants, and had also arranged part of it as a pinetum. His interest in his garden, his collections, and in natural life in many forms was retained to the end. He was elected a fellow of the Royal Society in 1883, and of the Linnean Society in 1887; he was also a fellow of London University, and the recipient of honorary degrees from Oxford, Cambridge, and other universities, including that of his native city, Bristol.

SIR W. H. THOMPSON, K.B.E.

SIR WILLIAM HENRY THOMPSON, who was a passenger on the R.M.S. *Leinster* when she was torpedoed in the Irish Channel on the morning of October 10, was a son of the late William Thompson, of Granard, Co. Longford. He was educated at the Dundalk Institution and at Queen's College, Belfast, and was a graduate in medicine of the Royal University of Ireland. After the outbreak of war, when the question of food supply became of paramount importance, he was able to give valuable help to the Royal Society's Committee on Food, of which he was a member. He became scientific adviser to the Ministry of Food shortly after its formation under Lord Devonport, and was made a Knight of the Order of the British Empire in January last in recognition of his services.

Thompson's first posts in medical education were demonstratorships at University College, Galway, and at the School of Anatomy, Trinity College, Dublin. In 1893 he was appointed Dunville professor of physiology, Queen's College, Belfast, as successor to the late Prof. Redfern. On the retirement of Prof. J. M. Purser in 1892 he was elected King's professor of the Institutes of Medicine, Trinity College, Dublin.

Thompson's scientific publications may be divided into several periods. The results of work, commenced at University College, London, in 1892, under the guidance of Sir E. Sharpey Schäfer, on degenerations resulting from lesions of the cortex of the temporal lobe appeared in the *Journal of Anatomy and Physiology*, vol. xxxv. Papers dealing with the nervous mechanism governing limb veins, and with the influence of atropine and morphine on the secretion of urine, which appeared in Du Bois Reymond's *Archiv* and in the *Archiv für Anatomie und Physiologie*, were the outcome of work in the Leipzig Physiological Institute. He published in a series of papers, down to the year 1900, the investigations which he carried out at the Sorbonne Physiological Laboratory, and at Queen's College, Belfast, on the effects on the circulation and on renal activity of peptone injections. A paper on the diuretic effects of sodium chloride, which brought forward evidence in support of Bowman's theory, belongs to this period.

After these papers, and as a result of work commenced in the physiological department at Marburg and continued at Heidelberg, Thompson's lines of research became more chemical. He attacked problems which were receiving close attention from Prof. Kossel—namely, those dealing with the physiological action of protamines and of their cleavage products. From this period onwards, during his tenure of the Dublin chair, his work developed along these lines. A long series of very important papers concerning creatinine and arginine metabolism appeared in the *Journal of Physiology* and in the *Biochemical Journal*.

For some years before the outbreak of war Thompson had been instrumental in gathering together a vast amount of statistical material dealing with the food supplies of Ireland and the dietary of the poorer classes.

A scientific colleague who was associated for a time with his work at the Ministry of Food writes:—"The very great value of Sir Henry Thompson's work as scientific adviser to the Ministry of Food can only be appreciated by those who had an opportunity of observing the patience and care with which he attacked every problem about which the authorities desired information."

Recently Sir Henry Thompson had been engaged in a series of investigations on the amount of work performed in different occupations, and the efficiency of the worker when so employed. He spent a short period in the Institute for Experimental Medicine in Petrograd, and afterwards published an English translation of the lectures on the work of the digestive glands delivered by Prof. Pavloff in 1897. The translation appeared in 1902, with the addition of a lecture by the translator on the passage of food through the alimentary canal.

The Lord Chancellor of Ireland, in a speech in support of a fund for the victims of the *Leinster* disaster, referred to Sir Henry's simplicity and earnestness of character, and said that in all human probability his journey to England would have been the last in his official capacity, as he had just been transferred to the Food Control Department in Dublin.

NOTES.

THE formal transfer of Stonehenge by Mr. C. H. E. Chubb, of Salisbury, to the nation, represented by the First Commissioner of Works, on Saturday last, was a simple but effective ceremony. One of the horizontal stones in the centre made a good platform, with the great monolith replaced by Prof. Gowland as a background. Mr. Chubb made a modest and interesting speech as to the motives which had inspired him to make this generous and patriotic gift to the nation, believing that so ancient a monument should never have been in private hands. He presented the deed of gift to Sir Alfred Mond, who, in accepting it, said he was authorised by the Prime Minister to express his personal appreciation of Mr. Chubb's public spirit. He gave great satisfaction by stating that it was his intention to make a sunken fence in lieu of the wire fence now existing, which interferes to some extent with the view of the monument. Sir Alfred Mond was accompanied by Sir Lionel Earle and by Mr. Peers, the Chief Inspector of Ancient Monuments. Sir H. C. Sclater, the General Commanding in Chief the Southern Command, said that the military authorities would co-operate with the Office of Works in protecting the monument. Other addresses were delivered by Sir C. Hercules Read, Sir Arthur Evans, and Mr. Heward Bell (representing the Wiltshire Archæological Society). Mr. Chubb's gift comprises not only Stonehenge itself, but also thirty acres of land surrounding it, the possession of which will be useful to the Office of Works in the measures it proposes to take for preserving and protecting the monument.

ADMIRAL SIR ALBERT HASTINGS MARKHAM, K.C.B., whose death occurred on Monday last, did much for the furtherance of knowledge in the Arctic regions. Entering the Navy in 1856, when he was fifteen years of age, he saw considerable service in the East before the fascination of polar exploration appealed to him, mainly through a paper which the late Admiral Sir Sherard Osborn read before the Royal Geographical Society in 1865. He was afterwards entrusted by the Admiral with the command of the whaler *Arctic*, in which he carried out a cruise to Baffin's Bay and the Gulf of Boothia. In 1875 he was appointed second-in-command of the Government Arctic expedition under Sir George Nares. In spite of many difficulties, he successfully navigated his ship, the *Alert*, into winter quarters on the north-east coast of Grant Land in latitude 82° 27′ N., which was the highest point then attained by ship or man. In the spring of the following year he set out over the ice of the Polar Sea in charge of the northern party and reached latitude 83° 20′ N. This was only seventy-three miles from the ship in a straight line, but the party covered no fewer than 276 miles on the outward and 245 miles on the homeward journey. In appreciation of his discoveries Admiral Markham was presented with a gold watch by the Royal Geographical Society; in later years he was a prominent member of the society's council. In 1879 he carried out an expedition to Novaya Zemlya in company with Sir Henry Gore Booth, and in 1886 studied the conditions of navigation in Hudson's Strait on board his old ship, the *Alert*, in connection with the Canadian Government's proposals for the establishment of a summer service between Fort Churchill and England. In the course of his career Admiral Markham contributed largely to the literature of polar exploration, and he wrote the biography (published last year) of his cousin, the late Sir Clements Markham.

WE regret to learn of the premature death of Dr. Charles Rochester Eastman, of the American Museum of Natural History, in his fifty-first year. Dr. Eastman was born at New Orleans, and completed his education at the University of Munich, where he studied palæontology under Prof. K. A. von Zittel, and graduated as Ph.D. in 1894. His thesis was an important memoir on a fossil shark, *Oxyrhina mantelli*, from the chalk of Kansas, and most of his subsequent researches were on fossil fishes. From 1895 until 1909 he was assistant for vertebrate palæontology in the Museum of Comparative Zoology, Harvard University, where he arranged and described the great collection of fossil fishes. From 1910 to 1912 he held a temporary appointment in the Carnegie Museum, Pittsburgh, where he published illustrated descriptive catalogues of the Eocene fishes from Monte Bolca and the Jurassic fishes from the lithographic stone of Germany and France. He also lectured on vertebrate palæontology in the University of Pittsburgh. In 1915 he became one of the newly instituted research associates of the American Museum of Natural History, New York. In 1900–2 Dr. Eastman did good service to biological science by editing two volumes of a revised English translation of Prof. von Zittel's "Grundzüge der Palæontologie," and during recent years he wrote several interesting papers on natural history in medieval books. He also co-operated with Dr. Bashford Dean in preparing the valuable and exhaustive bibliography of fishes, of which two volumes have lately been published by the American Museum.

MR. ARTHUR CANNON, whose death occurred on October 13, has left behind a valuable record of work accomplished. Following upon a distinguished career at Greenwich College, to which he passed from Devonport Dockyard, Mr. Cannon became assistant to Sir John Biles at Glasgow University. While occupying that position he was, in 1912, appointed to the research scholarship in naval architecture awarded by the Royal Commissioners for the Exhibition of 1851. The programme of research outlined by him included the experimental investigation of the rolling of ships amongst waves, and to that subject and others akin to it the two years of the scholarship were devoted. Beginning with a purely mathematical treatment of the effect of "loose" water upon stability, Mr. Cannon pointed out for the first time the valuable conclusion that the initial stability is at a maximum when the "loose" water admitted to the interior of a ship is at the same level as the water outside, but that this condition is the worst for stability at large angles of inclination. He then proceeded to investigate experimentally the effect of "loose" water upon rolling. This part of the research was carried out on the rolling machine at Glasgow University (a variation of Russo's navipendulum), and led to the conclusion that, whereas in ordinary circumstances the "free" oscillation is the dominant factor in rolling, in the case in which there is a considerable amount of "loose" water in the ship the "forced" oscillation is the dominant factor. The results of this research are of especial value in connection with the fitting of "anti-rolling" tanks, in that they indicate the beneficial effects of small quantities of loose water and the harmful effects of large quantities. A further research into the subject of the rolling of ships had reference to the period of roll at large angles of inclination. The full record of Mr. Cannon's research is contained in the Transactions of the Institution of Naval Architects, and its value was marked by the award of the annual premium to him by the council of the institution on two occasions. Through his untimely death at only thirty-two years of age the profession of naval architecture loses a valued member.

In 1914 Mr. Cannon was appointed Assistant Naval Constructor at the Admiralty, and at the time of his death he was the Admiralty overseer on submarine-building at Messrs. Cammell Laird and Co.'s yard, Birkenhead.

We regret to announce the death on October 9, at twenty-nine years of age, of Mr. Robert John Pocock, director of the Nizamiah Observatory, Hyderabad.

Dr. G. E. Moore will deliver his inaugural presidential address to the Aristotelian Society at 22 Albemarle Street on Monday, November 4, at 8 p.m., upon the subject of "Some Judgments of Perception."

The John Scott legacy medal and premium has, on the recommendation of the Franklin Institute, been awarded to Mr. F. P. Fahy in consideration of the development of the Fahy permeameter.

We much regret to announce the death on October 26, at eighty-seven years of age, of the Rev. A. M. Norman, F.R.S., honorary canon of Durham, and an eminent worker in many fields of natural history.

We notice with regret the announcement of the death on October 23, in his ninety-first year, of Mr. R. Brudenell Carter, the distinguished ophthalmic surgeon and author of several valuable works upon ophthalmic subjects.

Dr. A. Smith Woodward, keeper of the Geological Department of the British Museum (Natural History), has been awarded the Cuvier prize by the French Academy of Sciences. Other British recipients of the prize have been Sir Richard Owen, Sir Roderick Murchison, and Sir John Murray.

Dr. A. L. Day, who has been director of the geophysical laboratory of the Carnegie Institution of Washington since its establishment in 1906, has resigned the position to engage in research work on glass and allied materials for the Corning Glass Works, Corning, New York.

The hundredth session of the Institution of Civil Engineers will be opened on Tuesday, November 5, at 5.30 p.m., when Sir John A. F. Aspinall, president, will deliver an address, and will present awards made by the council for papers read and discussed or otherwise dealt with during the past session.

Prof. A. N. Skinner, formerly professor of mathematics at the U.S. Naval Academy and assistant astronomer of the Naval Observatory, died on August 14, aged seventy-three years. Prof. Skinner discovered four variable stars, and was responsible for 20,000 observations to determine the positions of 8824 stars for the *Astron. Gesell.* catalogue.

The death of Mr. Henry Westlake, at the age of seventy-two years, is recorded in the *Engineer* for October 25. Mr. Westlake was a prominent figure in South Yorkshire, and was for some years a director of Cammell Laird and Co., Ltd., and of the Workington Iron and Steel Co. For more than fifty years he was associated with the Staveley Coal and Iron Co.

We regret to note that the *Engineer* for October 25 records the death of Mr. J. F. L. Crosland, who was connected with the Vulcan Boiler and General Insurance Co. for forty-nine years, during the last twenty-four of which he was chief engineer of the company. Mr. Crosland was a member of the Institutions of Civil, Mechanical, and Electrical Engineers, and took a prominent part in legislation dealing with boiler accidents. He was seventy-nine years of age at the time of his death.

The death of Mr. Thomas Charles Hutchinson, the managing director of the Skinningrove Iron Co., is announced in the *Engineer* for October 25. Mr. Hutchinson was born in 1840, and played a great part in the development of the Cleveland district. He formulated a scheme for the erection of steel works in connection with the existing blast-furnace plant of his firm, adopted the new Talbot process, and installed the first electrically driven cogging mill in Great Britain. He took a keen interest in the Iron and Steel Institute and other kindred societies.

Mr. Thomas Codrington, who died on October 21, aged eighty-nine, was a civil engineer deeply interested in geology. For nearly sixty years he had been a fellow of the Geological Society, and he contributed several papers on the geology of Hampshire, the Isle of Wight, South Wales, and other districts. He discovered the only known petrified rootlets, probably of palms, in the tubular hollows of the Berkshire sarsen stones, and he was the first to recognise the gizzard stones in a fossil reptile, a Plesiosaurian which he found in the greensand of Wiltshire.

Engineering for October 25 records the death of Mr. Josiah Richard Perrett, who for many years was an active agent in the development of warship design in this country, particularly at Elswick. Mr. Perrett did valuable work in the earlier days of experimental research into the resistance of ships at Dr. Froude's tank. He was born in 1848, and received his training at H.M. Dockyard, Devonport, the Royal School of Naval Architecture, the Chatham Dockyard, and the Admiralty. He joined the Elswick shipyard in 1887 as first assistant to Sir Philip Watts. He received decorations from Japan, Italy, and Turkey; a paper by him was read at the last Newcastle meeting of the Institution of Naval Architects.

M. Paul Kestner, the president of the Société de Chimie Industrielle, a society which has been recently formed to promote the organisation and development of industrial chemistry in France, will deliver an address on "The Alsace Potash Deposits and their Economic Significance in relation to Terms of Peace" to the London Section of the Society of Chemical Industry on Monday next, November 4; the meeting will be held at the rooms of the Society of Arts, John Street, Adelphi, at 7.30 p.m. M. Kestner is being entertained to luncheon on that day by the Society of Chemical Industry, and the company will include Lord Moulton, Lord Burnham, Sir Robert Hadfield, Sir Alfred Keogh, Sir Alfred Mond, Sir Arthur Churchman, Sir Charles Parsons, Sir Boverton Redwood, Profs. Louis, Pope, and Armstrong, Dr. Keane, and other distinguished chemists and engineers, the Sheriffs of the City of London, and several chemical manufacturers representing this important industry. The guests are invited by the Lord Mayor to tea at the Mansion House in the afternoon.

At a meeting of the council of the Institute of Chemistry, held on October 25, it was reported by the General Purposes Committee that the position of the institute in connection with the proposals contained in the Whitley report had been under consideration. A letter had been addressed to the Minister of Labour pointing out that, although modern productive industry depended so much on the work of chemists, engineers, and the like, such technical experts do not appear to have any place in the constitution of the industrial councils; but, in view of the fact that it was proposed that the industrial councils should deal with such subjects as technical education and training, industrial research, utilisation of inventions and improvements, and industrial experiments, the Minister of Labour had been asked (*a*) whether it was intended that qualified professional technical experts should be represented on the industrial councils, and (*b*) whether it was desired that the professional bodies representing such men should be brought into consultation in any way in connection with the technical matters referred to. On the recommendation of the Public Appointments Committee, the council has approved a statement on the necessity for a definitely organised Government chemical service, which will shortly be brought to the notice of all Government Departments concerned.

The second and third Chadwick lectures on "The Story of a New Disease" were delivered by Dr. Crookshank on October 17 and 24. In the second lecture epidemic encephalo-myelitis (the Heine-Medin disease or infantile paralysis) was considered. First described by Willis in 1661, the disease has recurred again and again, frequently assuming different types, the latest in this country occurring during the present year and resembling in many respects "botulism," a form of food-poisoning. Two forms of so-called food-poisoning, raphania and botulism, were discussed in the third lecture. Raphania was the name given in the eighteenth century by Linnæus and his pupils to an epidemic disorder characterised by mental affections, paralyses, and convulsions, that spread throughout Sweden, and was ascribed by Linnæus to admixture of radish-seeds with foodstuffs. It has been confused by later German writers with ergotism. Botulism is a disease of the nineteenth century, usually traced to the consumption of sausage and allied comestibles. The lecturer suggested that both botulism and raphania are caused by the virus of the Heine-Medin disease, and directed attention to modifications in the soil (*i.e.* the individual) in causing varying manifestations of the viruses of epidemic diseases.

At the statutory meeting of the Royal Society of Edinburgh, held on October 28, the following office-bearers were elected:—*President:* Dr. J. Horne. *Vice-Presidents:* Prof. D'Arcy Thompson, Prof. J. Walker, Prof. G. A. Gibson, Dr. R. Kidston, Prof. D. Noël Paton, and Prof. A. Robinson. *General Secretary:* Dr. C. G. Knott. *Secretaries to Ordinary Meetings:* Prof. E. T. Whittaker and Dr. J. H. Ashworth. *Treasurer:* Mr. J. Currie. *Curator of Library and Museum:* Dr. A. Crichton Mitchell. *Councillors:* Sir G. A. Berry, Dr. J. S. Flett, Prof. Magnus Maclean, Prof. D. Waterston, Prof. F. O. Bower, Prof. P. T. Herring, Prof. T. J. Jehu, Dr. A. Lauder, the Hon. Lord Guthrie, Sir E. Sharpey Schäfer, Prof. J. Lorrain Smith, and Dr. W. A. Tait. Dr. W. A. Tait was also elected the society's representative on George Heriot's Trust.

A letter from Mr. Stefansson, written on July 20, from Fort Yukon, Alaska, is published in the *Geographical Journal* for October (vol. lii., No. 4), and gives some further details of the work of the Canadian Arctic Expedition during the last four years, additional to the discoveries of the southern party, which have already been announced. The north-west coastline of Prince Patrick Island and the north-east coastline of Victoria Island were completed. The coastlines of Emerald and Fitzwilliam Owen Islands and the shores of Hassel Sound between the two Ringnes Islands were mapped. Several new islands were added to the Arctic Archipelago, including one in the Gustav Adolf Sea between lat. 77° 0′ N. and lat. 77° 55′ N. in about long. 107° to 108° 10′ W., and another in Prince Gustav Sea. Christian Island and Findlay Land appear to be distinct, and Isachsen Land is probably separated from Ellef Ringnes Island. Relatively deep water was found outside Gustav Adolf and Prince Gustav Seas, making the existence of other islands to north-west improbable. Reindeer were found on all the islands visited, but musk-oxen only on Melville and Victoria Islands. On Banks Island they have been exterminated by the Eskimo attracted there by the wreck of Sir Robert McClure's *Investigator*, which they visited for iron year after year. Seals were plentiful on nearly all shores, but polar bears were very local. Mr. Stefansson had hoped to start in January this year on a sledge-journey northwards from Alaska. He had intended to travel about two hundred miles and then form an encampment on a floe and drift throughout the summer, taking soundings as he went. In this way he hoped to accomplish some of the work of the ill-fated *Karluk*. An attack of typhoid fever, however, forced his return to civilisation as soon as possible. We are glad to hear that he has now recovered and proposes to start a lecture-tour on behalf of the Red Cross.

Capt. F. R. Barton contributes to the Journal of the Royal Anthropological Institute (vol. xlviii., part i., 1918) an elaborate account of tattooing in south-eastern New Guinea, illustrated by excellent photographs and drawings, a vocabulary of the terms used in the art, and some folk-tales. One of the stories indicates the idea that tattooing was evolved from skin-painting and provides an interesting parallel to similar theories current among the Maoris of New Zealand.

In the issue of *Man* for October Mr. H. Balfour describes a collection made by Mr. Clough in the Chatham Islands, now deposited in the Pitt Rivers Museum, Oxford. The most remarkable specimens are a fine bone dagger and a grotesque statuette carved in pumice-stone. Mr. Balfour is not aware of any close parallel to these articles. As he has recently pointed out, the evidence of a strong Melanesian element in the culture of Easter Island is very striking, and inasmuch as the presence of a similar non-Polynesian strain in the culture of the Chatham Islands—and, one may add, in New Zealand—is becoming more generally recognised, the suggestion offered as to the possible affinities of these articles may have considerable bearing on the ethnological problems of the South Pacific.

A very useful summary of the captures of the North Atlantic black Right whale, or Nordcaper (*Balaena biscayensis*), in Scottish waters, from 1905 to 1914, is given by Prof. D'Arcy Thompson in the *Scottish Naturalist* for September. The grand total for this period amounted to sixty-seven, but, it is to be noted, two-thirds of this total were taken during 1908 and 1909. The marked inequality in the numbers annually taken seems to be accounted for by the movements of the Gulf Stream, since when its waters are abundant the whales are scarce. Prof. Thompson suggests that when the Gulf Stream is warm and strong the whales keep further out to sea, but that when there is only little stream they are tempted to linger on our coast. He is of opinion that this whale is far from becoming extinct, but the evidence does not seem to bear out this optimistic view. He also makes some interesting comments on its size, which is commonly regarded as smaller than that of the Greenland whale. The evidence, so far as it goes, he suggests, seems to show that there is little difference, if any, between them in this respect. Figures are also given showing the numbers of rorquals three species

—sperm, humpback, and bottle-nosed whales—taken at these stations during this period. The numbers are probably higher than most people would have supposed.

A NEW *Journal of General Physiology* is being published under the auspices of the Rockefeller Institute for Medical Research. The editors are Profs. Jacques Loeb and W. J. V. Osterhout. In the first instalment, which has just reached us, there are a number of interesting papers on photosynthesis, colloids, internal secretions, and regeneration in plants. Some doubt may be expressed, however, as to the need for another addition to the large number of journals devoted to experimental physiology and biochemistry.

THREE important papers dealing with methods of testing the hardness of materials were presented for discussion at the Institution of Mechanical Engineers on October 18. The first paper, by Prof. C. A. Edwards and Mr. F. W. Willis, describes an impact method. The instrument employed consisted of a block of steel weighing 21 lb., which could be released by a mechanical device and allowed to drop 3 in. to the surface of the specimen under test. The energy of the blow was imparted to the surface of the specimen through a hardened steel ball 10 mm. in diameter firmly fixed to the weight. The impact energy was the same in all cases, namely, 63 in.-lb. The specimen was held very rigidly in a heavy steel base, and the whole arrangement was carefully bedded on a massive steel table. In another machine both weight and height of fall could be varied, so as to give energies of impact between 1·75 and 147 in.-lb. The results obtained may be expressed by the equation $d = CE^{0.25}$, where d is the diameter of the indent made by a 10-mm. ball, C is a coefficient which varies with the hardness of the metal, and E is the total energy of impact. The second paper, by Mr. R. G. C. Batson, of the National Physical Laboratory, dealt with both static and impact methods. Within the limits of Mr. Batson's impact experiments it is shown that the energy of the blow is proportional to the volume of indentation for cone and ball indenting tools, and the dynamic hardness number suggested is equal to energy of blow in kg./volume of indentation in $cm.^3$ Further, the energy of the blow is proportional to the square of the spherical area of the indentation for ball indenting tool only, and the volume of indentation (and therefore the dynamic hardness number) is approximately independent of the form of the indenting tool (cone, 10-mm. ball, and 4·76-mm. ball). The third paper, by Prof. W. C. Unwin, deals with the Ludwik hardness test, in which geometrically similar indentations are made by use of a right-angled cone. Prof. Unwin suggests that a cone slightly truncated might be employed with advantage; such a cone is more durable than one with a sharp point, and the results differ slightly only. The discussion of these papers brought out a great deal of valuable information, and will be continued at the meeting on November 15.

AMONG forthcoming books of science we notice the following:—"Hot-bulb Oil Engines and Suitable Vessels," W. Pollock, and "The Production and Treatment of Vegetable Oils," T. W. Chalmers (*Constable and Co., Ltd.*); "Tri-lingual Artillery Dictionary," E. S. Hodgson, vol. ii., French-Italian-English, and vol. iii., Italian-French-English (*Charles Griffin and Co., Ltd.*); and a new and revised edition of the late D. K. Clark's "Mechanical Engineer's Pocket-book," H. H. P. Powles (*Crosby Lockwood and Son*).

OUR ASTRONOMICAL COLUMN.

THE PLANET JUPITER.—This brilliant object now rises at about 8 p.m., and is visible during the whole of the night which follows. Its position is between the stars δ and ζ in Gemini, and, the north declination being 22½°, the planet remains above the horizon during 16¾ hours. During the coming winter it will be very favourably situated for telescopic observation. Mr. Denning states that the great red spot continues faintly visible south of the hollow or bay in the south equatorial belt, and the former objects have exhibited an increasing velocity since 1900, when the rotation period was 9h. 55m. 41·5s. In the present year between May and August the period had declined to 9h. 55m. 31·4s., as determined by Mr. F. Sargent, of Bristol, from observations by the Rev. T. E. R. Phillips and himself. On May 12 the longitude of the red spot was 45°, and on August 9 25°.

If the same rate of motion has been maintained during the interval since August 9, then the present place of the spot is in longitude 6°, and it follows the zero meridian (system II.) given in the *Nautical Almanac* (1918, p. 541) by about ten minutes.

Early in December next the position of the red spot may be expected to correspond nearly with the zero meridian of system II., and will therefore transit at the same time. It will be interesting to observe the times of mid-transit of the red spot, which may be expected nearly as follows:—

		h. m.				h. m.
November	7	9 51 p.m.	December	1		9 28 p.m.
	9	11 28 ,,		4		6 55 ,,
	14	10 33 ,,		6		8 33 ,,
	19	9 40 ,,				
	24	8 45 ,,				

The hollow in the belt seems to have been certainly visible on Jupiter since Schwabe figured it on September 5, 1831, while the red spot appears to have been first seen and drawn by Dawes on November 27, 1857.

The "great south tropical disturbance," which is a very extensive dusky spot in the same latitude as the red spot, has been visible since February, 1901. It is now distended over about 185 degrees of longitude from 265° to 90°. Moving at a swifter rate than the red spot, it has had the effect of considerably accelerating the speed of the latter in late years.

THE RATE OF STELLAR EVOLUTION.—On the supposition that Cepheid variation is due to some kind of pulsation having the period of light variation, Prof. A. S. Eddington has pointed out that the variations of period indicated by theory may provide a means of estimating the rate of progress of stellar evolution (*The Observatory*, vol. xli., p. 379). The periods of similar globes of fluid pulsating under their own gravitation would be inversely proportional to the square roots of the densities, and the changes of density in a particular star might therefore be deduced from the change of period. Adopting Chandler's estimate that the period of δ Cephei (5·366 days) is decreasing 0·05 sec. annually, the star would double its density in rather more than three million years, and would take about ten million years to pass from type G to type F. This rate of change is much slower than that derived from the assumption that contraction is the source of the star's heat. The time-scale would, in fact, be enlarged a thousandfold, and would become more consistent with present views as to the age of terrestrial rocks, the development of the earth-moon system, and geological change. Observations of the change of period in Cepheid variables would therefore seem to be of possibly great importance, and it is fortunate that they can usually be determined with great accuracy.

THE INFLUENCE OF PROGRESSIVE COLD WORK ON PURE COPPER.

THE hardening effect of the various forms of cold work on metals and alloys has long been known and utilised in the arts, and in recent years various theories have been put forward to explain the phenomena observed. Few attempts, however, have been made to test whether any quantitative relationship exists between the amount of cold work done upon a metal and the magnitude of the change in its properties. A serious and well-planned attempt to obtain information of this kind has been made by Mr. Alkins, who presented a paper at the September meeting of the Institute of Metals on the change in the tensile strength of copper-wire as it is progressively hardened by cold-drawing in the ordinary way. Copper was chosen as the experimental material for the following reasons:—

(1) The wire used in the arts is of a high degree of purity, and seldom contains 1 part of impurity in 1000.

(2) It shows the hardening by plastic deformation very strikingly, inasmuch as its tensile strength may be doubled by cold-drawing without any indication that it is actually overdrawn.

(3) It has hitherto been accepted as a metal which does not possess any allotropic transformation between its freezing-point and 0° C. [Prof. Cohen, however, holds that there is evidence of an allotropic transformation at 71° C.]

In Mr. Alkins's experiments a billet of copper was cast and hot-rolled to a mean diameter of 0·553 in. in the ordinary way. The rolled billet was then annealed for four hours at about 600° C. in order to remove stresses completely, and was allowed to cool. After "pickling" in sulphuric acid to remove the scale it was cold-drawn by light drafts (twenty-five in all) down to 0·04 in. without any further annealing. From the billet after "pickling," and from the wire after each draft, a few feet were scrapped from the end, and three 2-ft. lengths cut for testing. The tensile strength of the wires was determined on a 5-ton Buckton machine. Five determinations were made on each sample of wire, and the readings were found to be concordant within 1 per cent. The mean of the five was taken as the actual breaking load. The results of the tests are shown in the accompanying graph, in which the co-ordinates are tensile strength in tons per sq. in. and sectional area in sq. in. It will be seen that the tensile strength is raised progressively from 15·49 tons in the original billet to 30·80 tons in the wire of the smallest sectional area. It will also be seen that the curve showing the variation of tenacity with sectional area consists of two rectilinear portions AB, CD, connected by a smooth curve BEC with a point of inflection at E. Mr. Alkins's analysis of the curve is as follows:—

The portion AB corresponds with the equation

$$T=31{\cdot}6-67A,$$

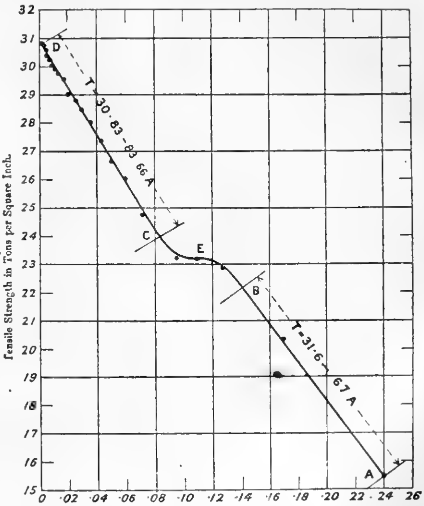
where T=tensile strength in tons per sq. in., and A=cross-sectional area in sq. in. The curved portion BEC agrees closely with the expression

$$T=23{\cdot}2-\sqrt[3]{A-0{\cdot}107},$$

and the upper rectilinear branch CD corresponds with the equation

$$T=30{\cdot}83-82{\cdot}66A.$$

According to these equations, then, from A to B the tensile strength increases at the rate of 67 tons per sq. in. for a reduction in area of 1 sq. in., while from C to D the rate of increase is 82·66 tons per sq. in. per sq. in. From B to E the rate diminishes to 0, and increases again from E to C. This curve shows no discontinuity, and at no stage is there a simultaneous diminution in sectional area and in the tensile strength. There is, however, one stage in the drawing at which a reduction of area of almost 10 per cent. (from 0·10927 to 0·095507 sq. in.) is unaccompanied by any change in the tensile strength. This corresponds with the point E, where the tenacity equals about 23·2 tons per sq. in. It appears, then, that over this particular range a reduction in area by cold work is not accompanied by any change in the tensile strength. Of this phenomenon the amorphous phase theory of plastic deformation does not appear to offer any explanation. Assuming, as Mr. Alkins does in the absence of quantitative data, that the amount of cold work actually performed on a metal during drawing is measured by the decrease in cross-sectional area, he is forced to the conclusion that two distinct changes occur in the hard drawing of copper, one of them along the branch AE and the other along the branch



ED. He states that he investigated several other physical properties of the metal as it was drawn down—for instance, density, elongation (both general and at fracture), and scleroscope hardness—and that all these were found to change in a similar way to the tensile strength. A full account of this and of further work is promised. Meantime, as a tentative explanation of the results recorded, he suggests that when copper is subjected to cold work by drawing through dies, the first change which occurs is allotropic in nature, and, after this is complete, a second change sets in which may be either allotropic or explicable on the lines of the amorphous theory.

Another set of experiments is quoted, in which wires were drawn down from the billet by heavy instead of light drafting, the reduction in area being accomplished in thirteen operations, as against twenty-five in the previous set. Here also the results yield a curve of the same type. It was found that over the range AE the values were identical with those obtained in the previous set of experiments, which appears to show that the transformation occurring after this range is constant is independent of the manner in which the cold work is applied. Beyond E, however, the new curve does not coincide with ED, but rises more steeply, the tensile strength corresponding with the 0·040 in. diameter wire, being nearly 33 tons per sq. in. It would appear, then, that the change taking place along ED is different in type from that occurring along AE. It is stated that wires of such a diameter that they fall within the range AE are stable at the ordinary temperatures. At any rate, they do not change in a year's time. On the other hand, wires corresponding with the points on the branch ED are unstable at atmospheric temperatures, their tensile strength being gradually diminished. Finally, Mr. Alkins records that, if fully annealed wire of any diameter is taken and drawn down, a stage is always reached, when its area has been reduced about 50 per cent., where, over a limited range, further drawing causes no corresponding alteration in the properties. He finds that the physical properties corresponding with this constant range are always the same—*e.g.* density=8·889, tensile strength=23·2 tons per sq. in., and so on. He concludes, therefore, that the point E corresponds with a definite physical state of the metal.

The facts thus brought forward by Mr. Alkins are of definite practical importance and distinct scientific interest. Considering the importance of the point E, it would have strengthened his case if he could have shown rather more observations in its immediate neighbourhood. This, of course, would have involved the preparation of a new set of rolls, by which very slight differences in area could be effected. Such work cannot, of course, be undertaken under war conditions. Further, he would have been well advised to determine the percentage of copper-cuprous oxide eutectic in his wire, which he did not do. This omission can, of course, be remedied, and until it is, and the influence of oxide specifically determined, no one can say how far his results are due to copper itself. If and when these omissions can be remedied, Mr. Alkins will improve a paper which already does him very great credit.

H. C. H. CARPENTER.

THE RAT PEST.

REFERRING to Prof. P. Chavigny's report on rats in the trenches (NATURE, September 19, p. 53), Mr. C. B. Moffat, Enniscorthy, points out that the descendants of a pair of rats must in three years far exceed the twenty millions stated. At the end of the first year there should be 50 offspring, 500 grand offspring, 1000 great-grand offspring, 1250 great-great-grand offspring—2800 in all. Half of this number, supposing females equal males, multiplied by 2800, gives 3,920,000 at the end of the second year. At the end of the third year the number should be far more than five thousand millions. It has to be borne in mind, however, that female rats probably reach their limit or menopause long before three years. The most secure data known to us are those of Helen Dean King (*Anat. Record*, vol. xi., 1916, pp. 269–87) on 76 females derived from a cross between the wild Norway rat and the domesticated white rat. The average number in a litter was 6·7 (Prof. Chavigny speaks of 10); the average total number of litters for a female was 7·7; there is a sharp decline in fertility after the female is a year old, and the menopause appears at eighteen months. The sex ratio for 3955 individuals was 106·1 males to 100 females. We do not know how Prof. Chavigny reached the figure twenty millions, but, as Mr. Moffat recognises, there are various biological considerations which make the computation not so simple as it seems at first.

Without doubt the most thorough and informative summary of the menace which faces us from the hordes of rats and mice in our midst has just been issued by the Trustees of the British Museum (Natural History), forming No. 8 of the Economic Series issued by that institution. The author, Mr. M. A. C. Hinton, one of the greatest living authorities on this subject, has marshalled his facts with extraordinary skill; so much so that he has contrived, within the space of some sixty pages, to pass in review, not only the life-history of these pests in a state of nature, their relation to public health, and their amazing destructiveness in the matter of our food supplies, but also the various preventive measures which afford us means of relief. On this head he has much to say in condemnation of the destruction of so-called "vermin," which, until now, has been so persistently and stupidly followed. Finally, he adds a most valuable chapter on the classification of the Muridæ, and a table showing the assumed rate of increase in the annual rat population, which, even while postulating a mortality which is purposely exaggerated, shows clearly enough that none but the most determined efforts can hope to lessen the seriousness of the situation, which has come about owing to the withdrawal of all labour hitherto devoted to the destruction of rats, either by the needs of the Army or by the allurement of the high wages paid for other kinds of work more or less directly arising out of the war. A number of well-chosen and beautifully executed illustrations, showing the dental and cranial characters by which our native species of Muridæ may be distinguished, add still further to the value of these pages. But the figures of the black and common rat and of the house-mouse, to say the least, leave much to be desired. This pamphlet should be carefully studied, not only by the agriculturist, the merchant, and those responsible for the preparation of food in restaurants, but also by the housekeeper; for it is only by the concerted efforts of us all that we can hope for success in this campaign, which is now to be commenced against a condition of affairs which is fraught with real peril.

THE RALEIGH TERCENTENARY.

THE tercentenary of Sir Walter Raleigh's death was celebrated on Sunday, October 27, by a special service at St. Margaret's Church, Westminster. The service was arranged by the Tercentenary Committee, of which the King is patron, Mr. Balfour one of the honorary presidents, and Prof. Gollancz hon. secretary. Two wreaths in memory of Sir Walter Raleigh were laid before the service at the foot of the Communion-table, where the body is said to have been buried. One was from the Tercentenary Committee; the other, of laurels, was from the Royal Geographical Society, and was inscribed: "To the memory of Sir Walter Raleigh on the tercentenary of his death." It was borne by Sir Thomas Holdich, K.C.M.G., and Mr. Arthur R. Hinks, secretary of the society. The address was delivered by the rector of St. Margaret's, Canon Carnegie. Memorial services were also held at the Temple Church and at Woolwich Parish Church. The work of Raleigh in exploration and colonisation was also commemorated on Tuesday by meetings at the Mansion House and elsewhere. At the Mansion House meeting Sir Charles Wakefield (hon. treasurer of the Tercentenary Committee) offered for the acceptance of the Lieutenant of the Tower a copy of Raleigh's "History of the World," which he hoped would find a place in the room where the history was written. He offered to the British Academy as the nucleus of a Raleigh Fund for History the sum of 500*l.* a year for at least the next five years, in the hope that it might not only advance historical learning among our fellow-citizens, but also help forward intellectual co-operation between American and British scholars. He would only stipulate that at least one public lecture be delivered annually, to be named after Raleigh.

At the Devon celebration of the tercentenary held at Exeter, Lord Fortescue, president of the organising committee, announced that he had received from Mr. Walter Peacock, Secretary to the Duchy of Cornwall, a letter to the effect that he was sure the proposal to celebrate the tercentenary would commend itself to the Prince of Wales and his Council, and suggesting that the proposed new University of the South-West should be styled the Raleigh University as a monument worthy of the man. Resolutions were carried that funds should be invited to this end, and a widely representative committee was appointed to co-operate with the existing committee for the furtherance of university education in the South-West.

Born of Devon parentage about the year 1552, Raleigh was the half-brother of Sir Humphrey Gilbert, another famous adventurer. In early life he served as a soldier in Ireland, but soon conceived plans for forming settlements in America, animated largely by hostility towards the Spaniards. An expedition sent by Raleigh to Newfoundland in 1583 resulted in the death of Sir Humphrey Gilbert. Raleigh then received from Queen Elizabeth the patent granted five years before to Gilbert to take possession "of any remote barbarous and heathen lands not possessed by any Christian prince or people." Quick to take advantage of his opportunity, he sent an expedition to America the same year. This expedition made a landfall in Florida and followed the coast northward to Pamlico Sound in North Carolina. A large tract of country which he did not reach Raleigh named Virginia in honour of Queen Elizabeth. In 1585 colonists were sent to Roanoke Island, but they soon had difficulties with the Indians, and the settlement proved a failure. Later attempts, in 1586 and 1587, met with no better success, and in 1589 Raleigh sold his rights in Virginia. Raleigh's next voyage of exploration was to South America in 1595, where, fired by stories of El Dorado, he hoped to find gold-mines. His "Discoverie of Guiana" gave an account of this expedition. Soldiering occupied Raleigh for some years, and, though high in Court favour, he was disliked in England for his arrogance and reputed greed. Soon after the accession of James I. he was accused of conspiracy and sent to the Tower. Many years later he was liberated in order to make a voyage to Guiana on the promise that the discovery of gold would obtain his freedom. The expedition achieved little, and Raleigh returned home and was beheaded in 1618. Gain and the hope of plunder were largely Raleigh's motives in his colonising enterprises, for he was in reality a pirate adventurer, but his work was of great importance in preparing the way for others and in helping to lay the foundations of Britain beyond the seas.

In connection with the tercentenary celebrations it is natural that some allusion should be made to the services Raleigh is commonly believed to have rendered to his country by introducing the potato. In the aggregate the literature of this plant would form a long series of volumes, and that dealing with its introduction into Europe and the British Isles is so copious that only the patient and leisured would care to study it thoroughly. This copiousness arises, no doubt, from the fact that, in spite of the reiterated statement that Raleigh brought the potato from Virginia, there is ample ground for controversy, and controversy there has been, leaving us very much shaken in our faith in the generally accepted account of its introduction by him. The appearance of the potato in the British Isles is supposed to date from 1586, and the tercentenary of its introduction was celebrated in 1886. But the first evidence we possess to show that the tuber was in cultivation in this country is that afforded by the catalogue of the plants in Gerard's garden in Holborn, published in 1596. Gerard, in his "Herball" of 1597, describes and figures it under the names of "Batatas Virginiana sive Virginianorum & Pappus, Potatoes of Virginia," and tells us that "it groweth naturally in America, where it was first discovered, as reporteth C. Clusius, since which time I have received rootes hereof from Virginia."

We learn from Clusius that the potato was cultivated in Italy in or about the year 1585, having probably been obtained from some Spanish source. It was taken to Belgium in 1586, and some tubers came into the hands of Philippe de Sivry, the prefect of Mons, who cultivated them, and sent, early in 1588, two tubers to Clusius at Vienna. It is thought that Gerard did not obtain the potato from Clusius, but, if the former may be trusted, it was obtained direct by him from Virginia. Gerard, however, is known to have handled the truth at least carelessly, and if he did not deliberately make a misstatement with regard to the origin of the plant, he was indifferent about it, and possibly wilfully suppressed information that would have elucidated the point. Introducers of plants of commercial value in later days have not always been quite candid as to their source. Gerard was probably proud of his possession of the potato, for his portrait, published in the "Herball," represents him as holding a flowering branch of the plant in his hand, and, for some reason obscure to us, may not have been disposed to divulge its origin. The late Sir James Murray, with his usual thoroughness, investigated the question of the introduction of the potato in connection with his article on the word in the New Oxford Dictionary. He says that Gerard "was in error in his statement that he obtained it from Virginia. In 1693 its introduction into Ireland was attributed to Sir Walter Raleigh after his return from Virginia (where he never was); but no contemporary statement associating Raleigh's name with the potato has been found."

It appears probable that the potato first reached this country as a result of one of Drake's expeditions to the New World, and it may have been brought on the vessel which, in 1586, conveyed to Plymouth the survivors of the ill-fated British colony in Virginia, and in the course of the voyage was probably taken with other booty from some Spanish ship. Drake as the introducer of the potato is so far accepted that a monument to him in commemoration of this was erected at Offenburg, in Germany, in 1854. It is extremely doubtful whether Raleigh had really any direct part in the introduction of the plant, but, according to Dr. Brushfield's painstaking researches, published in the Transactions of the Devonshire Association for the Advancement of Science (vol. xxx., pp. 158–97, 1898), it would appear that he was instrumental in extending its cultivation in this country and in popularising the tuber as a valuable food. He even says: "That Ralegh was the direct cause of the potato being brought to this land of ours can now scarcely be gainsaid; and to him must certainly be attributed the honour of promoting its cultivation in Ireland, from whence it was subsequently transmitted to England."

An interesting and able article on the subject, written by Dr. B. Daydon Jackson, appeared in the *Gardeners' Chronicle* in 1900 (vol. xxvii., pp. 161–62 and 178–80).

It is certainly as a populariser of the practice of smoking, and not as the introducer of the plant, that

Raleigh should be remembered with reference to tobacco. Its introduction was accomplished by Sir John Hawkins in 1565, and Raleigh early acquired the habit of smoking, which he succeeded in introducing to Court circles. Dr. Brushfield writes: "There can be no hesitation in affirming that Ralegh not only introduced it [tobacco] into general use in this country, but . . . was the first that brought it into fashion."

A BRITISH INSTITUTE OF INDUSTRIAL ART.

AT the Royal Society of Arts on October 28 the Right Hon. H. A. L. Fisher, President of the Board of Education, presided over a meeting called to consider a scheme for the promotion of a British Institute of Industrial Art. Mr. Fisher, in his introductory address, referred to the past history of industrial art in Great Britain, remarking that people in this country are apt to depreciate the national ability in artistic directions. What is needed is a centre to promote a closer relation between art and industry, and this the proposed scheme, which will involve the co-operation of the Board of Trade, the Board of Education, and the Royal Society of Arts, aims at providing. The chief feature of the scheme is a permanent exhibition to be held at the Victoria and Albert Museum, where representative works illustrating a high standard of British artistic craftsmanship will be shown. The exhibition should in time become self-supporting, and the nation would purchase annually a selected number of exhibits to form a permanent nucleus. The scheme also provides for a central fund to enable grants to be awarded for research and experimental work, institute scholarships, and initiate propaganda. Co-operation with the British School of Rome, with the view of enabling students to study Roman art, was proposed.

Lord Leverhulme, who opened the discussion, emphasised the importance of a shorter working day, combined with the more efficient use of machinery, in order to provide more leisure for study and artistic effort. Sir William McCormick remarked that the movement would be on parallel lines to the work of the Department of Scientific and Industrial Research, and mentioned several instances of processes—for example, the manufacture of fine porcelain—where scientific investigation and artistic effort could work in combination. Mr. Gordon Selfridge urged that a steady educational effort was needed before the public would sufficiently appreciate beautiful things to justify manufacturers in producing them. For the time being the scheme is to be administered by a representative executive committee, and it is hoped that ultimately sub-committees will be established to deal with the needs of individual industries requiring artistic talent.

CHEMICAL TECHNOLOGY AT THE IMPERIAL COLLEGE.

IN order to meet what seem to be the requirements of the post-war situation on a scale commensurate with Imperial needs, it is proposed to organise the future Department of Chemical Technology of the Imperial College of Science and Technology, South Kensington, so as to include the following four principal sections, namely:

I.—*Fuel Technology and Chemistry of Gases, with Refractory Materials.*

(*a*) General fuel technology, and the constitution of peats, lignites, and coals; (*b*) the carbonisation of coal and wood distillation; (*c*) the chemistry of coal-tar, ammonia, and the manufacture of intermediate products from coal-tar; (*d*) the chemistry of gases and technical gas catalysis, with special reference to the new developments in the manufacture of ammonia, nitric acid, sulphuric anhydride, etc., resulting from the war; (*e*) refractory materials, clays, earths, and sands, used in furnace construction and the manufacture of ceramics, glass, and cements; and (*f*) technical analysis connected with the foregoing.

The arrangements contemplated under (*e*) would include some provision for investigating the materials used in the manufacture of *optical glass*, which it is hoped will be a useful adjunct to the new Department of Technical Optics; those under (*b*) meet the need, already felt in many quarters, of an adequate provision being made in this country for the scientific study of *wood distillation*, etc., in the interests of India and the Empire generally; and those under (*a*) will provide for an extension of the important investigations on lignites which have already been instituted in the Department during the war in the interests of the Dominions.

II.—*Chemical Engineering.*

Advanced study and investigations upon (*a*) the materials and principles involved in the design, construction, and use of plant for such general factory operations as the transportation of solids, liquids, and gases; filtration, desiccation, extraction, distillation, evaporation, crystallisation, etc.; condensing plant; the cooling, cleaning, and scrubbing of gases; the refining of solids, the concentration of acids; autoclaves and pressure plant, etc.; (*b*) the design and construction of foundations, flues, chimneys, etc.; and (*c*) factory economics and organisation. The underlying idea of this section of the Department's work is that students shall be trained in the working out of designs of commercial plant from their own notes and experimental work, including the drawing up of plans and specifications, and the organisation of factories in which the above-mentioned operations are carried out.

III.—*Electro-Chemistry.*

This section is to be developed so as to include broadly the principal applications of electricity in chemical industry, and especially to the many processes which are dependent upon the electrolytic or ionising actions of currents. These include, *inter alia*, the manufacture of caustic alkalis, chlorine, hypochlorites, etc.; "peroxidised" products such as persulphates, perchlorites, permanganates, etc.; also white lead, and such metals as sodium, magnesium, aluminium, calcium, etc. Also many organic substances are nowadays made by electrolytic "reduction" or "oxidation" processes.

The value to this country of such processes has been emphasised by the experience of the war, and it is more than ever important for the well-being of our chemical industries that no time should be lost in developing at this college a sub-department in chemical technology for the special study of them.

IV.—*Technology of Carbohydrates, Fats, Oils, and Rubber.*

The selection of the subjects to be included under this section has been largely influenced by two considerations, namely:—

First, the already large provision (*a*) in Manchester, Leeds, and Huddersfield for advanced study and research upon dyes and tinctorial chemistry, as applied to the great textile industries of the country; (*b*) in Leeds and in London in connection with the leather industries; and (c) in Birmingham in respect of the fermentation industries; and, secondly, the lack of any really adequate provision in this country for the needs of equally important branches of industry which depend upon the extraction and refining of certain well-defined groups of natural (and chiefly vegetable) raw materials.

The technology of the following groups of natural products has been selected because of their increasing economic importance, and of their close relationships with the work already developed in the botany department. It can scarcely be doubted that the study and investigation of their chemical properties, treatment, and uses in the Department of Chemical Technology will constitute an important link, not only with the work of the botany department, but also with the economic development of the vegetable resources of the Empire, on which grounds their adoption by the college may be urged as specially appropriate. The products in question are as follows:—(i) Celluloses, sugars, starches, gums, dextrins, and resins; (ii) animal and vegetable oils and fats, and the manufacture of glycerine, soap, and food products (e.g. margarine) therefrom; and (iii) rubber and similar materials.

Industrial Connection.

In the development of the foregoing scheme as a whole, emphasis is to be laid upon the importance of everything possible being done, both now and in the future, by way of establishing and extending connection between the various sections of the Department and the industries which they are severally designed to serve. The Department will also keep in close touch with the various organised efforts that are now being made to solve general industrial and economic problems by co-operative investigation and research.

The additional financial requirements for the important developments outlined above are estimated at 100,000*l.* for buildings and equipment, and not less than 10,000*l.* a year for maintenance and working expenses.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—The following doctorate has been conferred by the Senate:—*D.Sc.* (*Engineering*): Mr. Miles Walker, an external student, for a thesis entitled "Supply of Single-phase Power from Three-phase Systems."

Teachers have hitherto exercised but little influence on the public educational systems of this country. But if the public authorities that control this education are to exercise their growing power to the best advantage, they can scarcely do so without the increasing help of the teaching profession. The Teachers' Registration Council—"representative of the teaching profession"—was established in 1912. During its short life it has rendered valuable service to English education by preparing a register of teachers and by providing a teachers' parliament. But if the teaching profession is to take an effective part in directing a new national system of education, it can best do so by co-operating with the existing authorities on the lines indicated by the Whitley report. The initiative will probably have to come from the teachers. The Teachers' Registration Council can provide their side of the "Joint Industrial Council," but provincial councils of teachers are needed to provide their side of the "district councils." Accordingly a new step has been taken by the formation, at a meeting held in Manchester on October 26, of the first provincial council, representative of the teaching profession in Lancashire and Cheshire. The council consists of two representatives of each of the Universities—Manchester and Liverpool—and of the teachers' associations in these counties. It is anticipated that other provincial councils will quickly be set up elsewhere. Their establishment throughout the length and breadth of England will not only enable the teachers to exercise a profoundly beneficial influence upon the organisation of local education, but also be the means of securing a greater measure of life and liberty for the teaching profession.

SOCIETIES AND ACADEMIES.

London.

Optical Society, October 10.—Prof. Cheshire, president, in the chair.—T. Y. **Baker**: Sources and magnitude of centring errors in a sextant. A centring error in a sextant is ordinarily due to the sextant being placed eccentrically on the dividing engine. In order to comply with the National Physical Laboratory's "A" class certificate, it is necessary that this eccentricity should not be such as to produce errors in the reading exceeding 40 seconds. This condition is satisfied provided the scale-centre lies within a certain ellipse the centre of which is the mechanical centre of the instrument,, and the axes of which lie one along and the other at right angles to the line of the middle reading. The semi-axes of this ellipse for a 7-in. sextant reading up to 120 are 5·2 mils and 0·7 mil respectively, but the former figure needs reduction to about 3 mils in order to allow of the vernier not reading "long" at the two ends of the scale. The customary practice of sextant-makers has been to re-adjust the position of the mechanical centre after the instrument has had the scale engraved. The workshop method of testing whether such readjustment is necessary is customarily the method of trying the length of the vernier against the scale at different points along the arc. The author showed that this method is not a sufficiently delicate test for the purpose of complying with the "A" certificate. An alternative method was described, in which the correctness or otherwise of the centre is determined by the tracing of a mark engraved upon the vernier against a circular arc cut from the same centre and at the same time as the marking of the scale. This method is being adopted by the Admiralty, and is already embodied in their specification for cadets' sextants.—T. **Chaundy**: Astigmatism: interchangeability of stop and object. For an object at O and a stop at S on the axis of an optical instrument, the astigmatism (*i.e.* astigmatic separation divided by the square of the height of the object) is to least order

$$\mu(1 - FO.FS/f^2)/\mu'.SO,$$

together with a quantity symmetrical in O and S. The planes of stop and object may thus be interchanged without change in value of the astigmatism if $FO.FS = f^2$. In this case, with like end-media, F′, S′, O′ (the images of F, S, O in the instrument) are symmetrically placed with respect to F, O, S. In particular, an object at one focus and a stop at the other are interchangeable. The astigmatism in this case is unaltered by reversal of the instrument; its consequent convenience in calculation is pointed out. In particular, all the primary aberrations may be determined by differentiation of its expression in terms of the powers and separations of the system.

Royal Microscopical Society, October 16.—J. E. **Barnard**: A new illuminant for microscopical work. Note on the reports of the Medical Research Committee on the standardisation of pathological methods.

SYDNEY.

Royal Society of New South Wales, August 7.—Mr. W. S. Dun, president, in the chair.—R. T. **Baker**: The technology and anatomy of some "silky oak" timbers. This paper covers an investigation into the technology and anatomy of five species of timber-yielding trees belonging to the natural order Protaceæ, and all vernacularly known as members of the "silky oak" family. Two belong to the same genus, viz. *Grevillea robusta* and *G. hilliana*, the others being *Orites excelsa*, *Cardwelli sublimis*, and *Embothrium wickhami*. Their economic applications are enumerated, and the suitability of some of them for flying machines adds a new timber to those valuable arms of the Empire—the Navy and Army. Breaking strains, specific gravities, and weights of each are given.—R. H. **Cambage**: Vertical growth of trees. From tests made for several years on very young trees it appears that after the branches are thrown out the trunk does not increase in length to any appreciable extent below such branches, but the prolongation comes from the terminal shoot or growing point at the summit. Nails which were driven into very young acacias, cinnamomums, and eucalypts at 4 ft. and 5 ft. from the base were not carried upwards during several years or while the little tree-stems grew to double their length.

BOOKS RECEIVED.

The Physical Society of London. Report on the Relativity Theory of Gravitation. By Prof. A. S. Eddington. Pp. vii+91. (London: The Fleetway Press, Ltd.) 6*s*. net

Jungle Peace. By W. Beebe. Pp. 297. (New York: H. Holt and Co.)

What is War? and Two Other Essays. By H. B. Cowen. Pp. 38. (London: The Cursitor Publishing Co.) 9*d*.

Psychological Principles. By Prof. J. Ward. Pp. xiv+478. (Cambridge: At the University Press.) 21*s*. net.

On the Nature of Things. By H. Woods. Pp. v+248. (Bristol: John Wright and Sons, Ltd.) 10*s*. 6*d*. net.

The Life and Letters of Joseph Black, M.D. By Sir W. Ramsay. With an introduction dealing with the life and work of Sir William Ramsay by Prof. F. G. Donnan. Pp. xix+148. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

The Ontario High School Laboratory Manual in Chemistry. By Prof. G. A. Cornish, assisted by A. Smith. Pp. vii+135. (Toronto: The Macmillian Co. of Canada, Ltd.) 25 cents.

The Ontario High School Chemistry. By Prof. G. A. Cornish, assisted by A. Smith. Pp. vii+297. (Toronto: The Macmillan Co. of Canada, Ltd.) 50 cents.

Far Away and Long Ago. By W. H. Hudson. Pp. xii+332. (London: J. M. Dent and Sons, Ltd.) 15*s*. net.

Interpolation Tables or Multiplication Tables of Decimal Fractions. By Dr. H. B. Hedrick. Pp. ix+139. (Washington: The Carnegie Institution of Washington.)

Dictionary and Grammar of the Language of Sa'a and Ulawa, Solomon Islands, with Appendices. By W. G. Ivens. Pp. vii+249+11 plates. (Washington: The Carnegie Institution of Washington.)

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. ix. Pp. 362+105 plates. (Washington: The Carnegie Institution of Washington.)

DIARY OF SOCIETIES.

MONDAY, NOVEMBER 4.

ARISTOTELIAN SOCIETY, at 8.—Dr. G. E. Moore: Presidential Address, Some Judgments of Perception.

SOCIETY OF ENGINEERS, at 5.30.—Sir Richard Cooper, Bart.: Obstacles to Post-war Trade.

TUESDAY, NOVEMBER 5.

MINERALOGICAL SOCIETY, at 5.30.—Anniversary Meeting.—Dr. G. F. Herbert Smith and Dr. G. T. Prior: A Plagionite-like Mineral from Dumfriesshire.—Lt. Arthur Russell: The Chromite Deposits in the Island of Unst, Shetlands.—Dr. G. T. Prior: The Nickeliferous Iron of the Meteorites of Bluff, Chandakapur, Chateau Renard, Cynthiana, Dhurmsala, Eli Elwah, Gnadenfrei, Kahowa, Lundsgård, New Concord, Shelburne, and Shytal.

RÖNTGEN SOCIETY, at 8.15.—Dr. G. B. Batten: Presidential Address.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Sir John A. F. Aspinall: Inaugural Address, and Presentation of the Medals recently Awarded by the Council.

ZOOLOGICAL SOCIETY, at 5.30.—Prof. H. M. Lefroy: The Sydney Zoological Gardens.—Dr. R. T. Leiper: (1) Diagnosis of Helminth Infections from the Character of the Eggs in the Fæces; (2) Demonstration of the "New" Rabbit Disease.—J. F. Gemmill: Ciliary Action in the Internal Cavities of the Ctenophore, *Pleurobrachia pileus*, Fabr.

WEDNESDAY, NOVEMBER 6.

SOCIETY OF PUBLIC ANALYSTS, at 5.—H. Droop Richmond: Note on the Graduation of Gerber Butyrometers.—E. G. McLellan and A. W. Knapp: The Estimation of Cacao Shell.

GEOLOGICAL SOCIETY, at 5.30.—Major Sir Douglas Mawson introduces Discussion on the Antarctic Ice-sheet and its Borders.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Prof. G. E. Hale: The Nature of Sun-spots.—E. O. Hercus and T. H. Laby: The Thermal Conductivity of Air.—T. K. Chinmayanandam: Haidinger's Rings in Mica.

CHEMICAL SOCIETY, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Tenth Kelvin Lecture—L. B. Atkinson: The Dynamical Theory of Electric Engines.

FRIDAY, NOVEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 7.—The Rev. Dr. A. H. Cooke: The Radula of Thais, Drupa, Concholepas, Cronia, Rapana, and the Allied Genera.—W. T. Webster: Notes on the Life-history of *Planorbis corneus* and other Freshwater Mollusca.

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

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THURSDAY, NOVEMBER 7, 1918.

RECONSTRUCTION.

National Reconstruction: A Study in Practical Politics and Statesmanship. By J. J. Robinson. Pp. x+155. (London: Hurst and Blackett, Ltd., 1918.) Price 2s. 6d. net.

"RECONSTRUCTION," like Mesopotamia, is a blessed word, and already there exists a considerable literature to expound its illimitable possibilities. The value of that literature is not equal to its bulk, for the writers too often have been misled by some passing phase of a rapidly shifting situation, or are the victims of doctrinaire theories or, worse, of "the Phrase," which Mr. Robinson notes "is very real and oppressive just now—the artificial and captivating jingles which are often made to do duty for facts and for reasoning from facts." If we had not enough already of "the monstrous regiments of people paid to get other people to do things," there would be justification for a censor who would refuse to pass for publication books on "reconstruction," unless they were written by those who combined some training in disciplined thinking with adequate experience of administrative problems—the perennial difficulty, in short, of achieving demonstrable progress by the machinery of institutions, working on, and worked by, men and women as they really are. The defects of the average administrator and the limitations of machinery are too commonly forgotten by those who assume in three hundred and fifty pages that a new British Empire can be created by a crop of committees and an encyclopædia of legislation in a few years "after the war."

Mr. Robinson would pass the suggested censor's test. His pages prove to a practised eye that he has thought deeply and read widely, while his administrative training has been varied and prolonged. He has, therefore, a right to summarise his experience. Moreover, he summarises it concisely, with freshness of expression and a stimulating conviction. Mr. Robinson certainly does not pretend that the monopoly of truth is on his writing-table, for he fully recognises that there are seventy-seven ways of constructing tribal lays, and that every single one of them is right. We certainly wish that Mr. Robinson could lure into "the school" where "he still is" as many politicians and voters, new and old, as possible and keep them there until peace was signed, sealed, and delivered. An old-fashioned parent once ascribed the success of his sons and daughters to the continuity and impartiality of his discipline. "I whipped my boys," he said, "to knock sense into them, and my girls to knock nonsense out of them." A course of Mr. Robinson would knock much sense into, and much nonsense out of, the young men and women who alone can be the "reconstructors" of the Empire. The future of "reconstruction" lies with the young, not with the middle-aged or the old, paralysed by the ignorance, apathy, and superstitions of the pre-war generation. One of Mr. Robinson's best lessons is that both the beginning and the end turn on the individual, "the mobile and mobilisable unit of power"—and if the unit fails we shall not even muddle through. Some of the instruction that the unit sorely needs can be found in Mr. Robinson's pages, and also much of the inspiration to discover more in life itself and in the inexhaustible potentialities of disciplined individual character.

It is not possible here to compress this valuable little book into a tabloid which a reader of reviews can swallow and imagine that he is thereby absolved from any further effort. We take it that the gist of Mr. Robinson's thesis is contained in his remark: "The history of civilisation up to 1917 is the history of power in unfit hands"; and the gist of his practical lesson is to show how "the unfit hands" can be made fit. We are supposed now to be on the eve of a General Election, the results of which presumably will be to determine by whom the work of "reconstruction" is to be achieved in the next five years. It would be salutary, indeed, if every candidate for Parliament and every voter had at every meeting in the election period to answer publicly in the presence of his fellow-voters, male and female, the catechism outlined in pp. 79–84—salutary and most humiliating. That catechism expands, but not unduly, the famous question: "If these things" (and we all know what "these things" are, the ills, mental, moral, physical, and social, from which we all individually and corporately suffer) "are preventable, why are they not prevented?"

We shall not misinterpret Mr. Robinson's "gospel" if we sum it up as a chain of proofs that what reconstruction demands is not so much a new theory of the State and citizenship as a new type of citizen, in whom knowledge is the teacher of duty, and duty the fruit of knowledge. Finally, Mr. Robinson concludes with a warning, so apposite and true and so often ignored that it must be quoted:—

"It may be difficult," he pronounces, "to get general readers, or popular audiences, to realise that Germany's intensive cultivation of war is neither the most dangerous nor perhaps the most considerable of her contributions to human experience and possibilities. . . . Surely it must be patent that the modern German Army is but the child of something more momentous. . . . Germans have attempted and achieved a Germanism which, after the war, will and must remain a perpetual challenge to other nations more loosely organised, less sternly schooled by the disciplinary education Germany subjected herself to for national ends . . . the German people will remain . . . it will not be met and mastered by anything less industrious and zealous than itself. By no machinery of voting, or credence given to empirical ignorance, can the slothful, the ignorant, and the disorganised close the highways of the world against the energetic, the educated, and the organised." "Is it necessary," asks Mr. Robinson, "for the moral to be the more stupid man? Is it possible for him to win if he ordinarily is?" The affirmative answer does, indeed, "draw cheques on the universe which it has never yet honoured." The negative answer and how to secure it the reader will find in Mr. Robinson's pages.

APPLICATIONS OF COAL-TAR DYES.

Modern Dyeing Methods: The Application of the Coal-tar Dyestuffs: The Principles Involved and the Methods Employed. By C. M. Whittaker. Pp. xi+214. (London: Baillière, Tindall, and Cox, 1918.) Price 7*s*. 6*d*. net.

THIS is one of a series of eighteen volumes (published or in course of preparation) edited by Dr. Samuel Rideal, and intended to give a comprehensive survey of the chemical industries, as set forth in the general preface which precedes that of the author. It cannot be said that the author has followed this well-conceived plan so conscientiously as he might have done; in fact, the only point to which he has rigidly adhered has been the subdivision of his subject into sections. We are promised in the general preface that "there will be a general bibliography, and also a select bibliography to follow each section." Such bibliographies (coupled with references to current literature) would have represented a most valuable adjunct to a small work such as this, in which the treatment of so vast a subject is attempted, but all that is given (except a few references in the text) is a very incomplete list of works and current publications on pp. 10 and 11, while no select bibliographies follow the sections. The scope of the work is, however, ill-defined, for it bears no fewer than three titles, namely, Modern Dyeing Methods, The Application of the Coal-tar Dyestuffs (both on the title-page), and Dyeing with Coal-tar Dyestuffs (on the cover); strictly speaking, each of these subjects would require different bibliographies. The second heading is, however, the one under which the book is advertised in the general list, and one would certainly have expected the textile printing, lake-manufacturing, and paper-making industries to receive due consideration, but the two former are ruled out for lack of space, while the third is only cursorily mentioned in one or two places.

The dyestuffs are correctly subdivided under the various sections according to their mode of application in dyeing, and not according to their chemical constitution. Their application in the dyeing of the various classes of textile fabrics is generally adequately described, and many practical hints are given which may prove useful to the dyer. But, apart from inaccuracies, there is a certain looseness in the style which may in some cases lead to confusion. In some sections the author gives (*e.g.* on p. 12) a list of the principal classes of compounds from a chemical point of view, with a typical example of each. Thus the triphenylmethane dyestuffs are represented by magenta (the formula given is actually that of *p*-rosaniline hydrochloride, but this is of minor consequence); while on p. 13 the azo-dyes of basic character are typified by Bismarck brown (with an incorrect formula), but there is nothing to indicate that these are only typical examples. The grouping of the acid dyestuffs on p. 28 is a little clearer, but still requires some further explanation, and the same applies to the artificial mordant dyestuffs on p. 40. In the three later sections dealing with the direct cotton dyestuffs, the insoluble azo-colours, and the eosines respectively, no examples at all are given. Not only do we find such inconsistencies, but there is also displayed in many cases a lack of the sense of proportion. Thus, while on p. 19 particulars are given of two methods (*a* and *b*) of applying basic colours in cotton-dyeing, which are seldom, if ever, used to-day, the direct method, which is very useful for light shades, and ensures good penetration and level dyeing, is not even mentioned.

The last section is devoted to the valuation and detection of dyestuffs, but it is very inadequately handled. No mention is made of any of the exact quantitative methods of estimating dyestuffs which are in use at the present time, while with regard to the identification of dyestuffs on dyed fabrics the author, after referring the reader to Prof. A. G. Green's excellent work on the subject, contents himself with giving a few practical hints or tips, including two for the detection of "faked" indigo.

Altogether, the work is disappointing, and adds little, if anything, to our present knowledge of the subject.

THE MEASUREMENT OF TEMPERATURE.

Methods of Measuring Temperature. By Dr. Ezer Griffiths. With an Introduction by Principal E. H. Griffiths. Pp. xi+176. (London: Charles Griffin and Co., Ltd., 1918.) Price 8*s*. 6*d*. net.

IT is a pleasant task to welcome this work by Dr. Ezer Griffiths, of the Heat Department of the National Physical Laboratory. During the last few years it has been necessary to refer to text-books written by our Allies rather than to works written by British men of science when general information on temperature measurement is required. This has been particularly unfortunate, as so much of the fundamental work in thermometry is due to Englishmen.

Principal E. H. Griffiths, in an interesting introductory reminiscence, points out the great advances that have been made in the subject during the last thirty years. He states that "our knowledge of the temperature scale about 1600° C. is comparable both in facility and accuracy with our measurements some thirty years ago in the neighbourhood of 600° C." That this is no exaggeration a glance at the chapters on "The Fundamental Scale of Temperature" and "High-temperature Melting-points" will show. In the former chapter Dr. Ezer Griffiths summarises the work done in gas thermometry, the most difficult of all thermometry. He points out that the discovery of the monatomic gases with no chemical affinity has made available elements which approach the "ideal gas" nearer than hydrogen or nitrogen. Argon will probably be employed in all the higher temperature gas thermometry because it does not diffuse readily through quartz.

In the chapter on the mercurial thermometer some useful information is given as to the construction of the electrically heated testing baths now in use at the National Physical Laboratory; indeed, one of the not least valuable features of the book consists in the data and illustrations given of the thermometer and pyrometer testing equipments of this laboratory.

The chapters on the resistance thermometer and the thermo-couple show that a great deal of experimental work has been devoted to developing the precision of the results obtained with these instruments. It is to be regretted that the author has not been able to deal more fully with their commercial development. We notice the omission of Peake's compensating leads and the very brief mention of the modern recording instruments, base metal thermo-couples, etc.

Four interesting chapters are devoted to the study of radiation and optical pyrometers and the problems connected with them. From the scientific, as well as from the industrial, point of view, the measurement of very high temperatures is of great interest. The instruments in themselves are comparatively simple, but the extrapolation of their scales beyond 1400° C. is a problem of considerable difficulty. A large number of workers will be grateful to Dr. Ezer Griffiths for the concise summary of the work on which this extrapolation is based.

In connection with the explanation of the Wanner optical pyrometer, it should be pointed out that the images of the illuminated patches are circular (being images of the circular diaphragm), and not semi-circular, as stated. The description of the instrument on p. 120 is not so accurately worded as it should be. The diagram is not well printed, and is thus difficult to understand.

A useful bibliography is given at the end of each chapter. A small slip on p. 55 may be mentioned; for Tables xlix. and l., xlvii. and xlviii. should be substituted.

The book is a useful, short summary of the subject, and, although not so complete as one would have desired, may be recommended as an addition to the library of every physics laboratory.

OUR BOOKSHELF.

Biology of Sex for Parents and Teachers. By Dr. T. W. Galloway. Pp. 128. (London: D. C. Heath and Co.; n.d.) Price 2s. net.

CONVINCED of the need for sex-instruction, Dr. Galloway seeks to give parents and teachers some idea of the biological and ethical principles which should underlie it, and to suggest the spirit in which it should be attempted. He has sympathy with endeavouring by knowledge to avoid disaster, but he sees positive promise in trying to use the sex impulses and instincts educatively. He seeks to present the facts of sex in their broad biological and evolutionary setting, and the lines of instruction suggested seem to us to be shrewd and wise. He would in a graduated and differential way explain to young people that if their sex-development goes awry, the results will show themselves in reducing the efficiency of body and mind. "The purpose of sex-knowledge is to enable you to let yourself develop normally without giving the matter any unnecessary thought." But the power of control over impulses requires strengthening even in the strongest, and the author writes in an experienced, practical way of the ideas and ideals, habits and interrelations that make it less difficult to "keep the heart with all diligence."

Emphasis is wisely laid on the importance of grading the instruction according to intellectual and emotional development and the diversity of social and economic relations. The linking of sex-instruction to biology and hygiene on one hand, and to ethics and eugenics on the other, is a good feature of a concise and clearly written book which can be confidently recommended to parents and teachers. Now and again we have come across a sentence that jars (*e.g.* on p. 119: "Because of this shell, chickens cannot behave like fish in fertilising the egg"), but the workmanship of the book is thoroughly competent.

The Processes of History. By Prof. F. J. Teggart. Pp. ix+162. (New Haven: Yale University Press; London: Humphrey Milford, 1918.) Price 5s. 6d. net.

THE main argument of this essay is that historians should take into account the natural processes that have moulded human groups, and that the history of no one area can be viewed independently of that of its neighbours. A powerful plea is put forward for the recognition of a history of Eurasia, in which Western events may be treated as the outcome of climatic and other incentives to movement in the broad lands lying to the East. The author urges that Lyellian methods cannot be applied to history, though correct inferences from historic data "should be verifiable by application to things as they are." Our range of view, in seeking for causes of human action, cannot be restricted by epochs and localities, and the dominance of mere narrative in history seems already overthrown. Prof. Teggart regards primitive man as engaged in maintaining a system of life which he has found sufficiently advantageous. In thus minimising the influence of the gifted and ingenious member of the tribe, or of the hunter whose adventurous outlook has brought him into open country from the confining darkness of the woods, he strikes a blow at the theory of leadership as a cause of rapid change and evolution. Tribal movements appear to him to originate in some broad change of condition, and the migration thus enforced by Nature leads to development by collision with men who have followed other modes of life. The book will perhaps be of service in pointing out the problems rather than the methods of modern history.

G. A. J. C.

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 Perception of Sound.

PROF. KEITH has replied to the physiological criticisms in Prof. Bayliss's most thoughtful letter in NATURE of October 17. I will therefore confine myself principally to the physical objections he has raised.

With regard to the difference between the molecular movement of a liquid subjected to the pressure of a sound-wave, and the molar motion of a minute mass of liquid in the cochlea, it cannot be forgotten that liquids could not conduct sound "unless they were both elastic and compressible."

The fact that water is so difficult to compress, and this only at very high unit pressures, is proof of its high degree of elasticity or tendency for its molecules to return to their undisturbed positions. But an extremely low unit pressure will cause molar motion in a small mass of liquid moving in a vessel of suitable shape. It is to such molar motion that I refer. A reference to my footnote (p. 56 of my book) shows that Helmholtz in his later studies recognised that "an incompressible fluid contained between solid walls is distinguishable from a compressible one in this: that every impulse which reaches any part of its surface communicates itself immediately throughout the whole fluid and sets every part instantly in motion, while in a compressible fluid a wave proceeds from the spot of action and travels with a certain velocity, setting in motion the several particles of the fluid consecutively. Thus if the dimensions of the whole mass are infinitely small in comparison with the wave-length (as it is in the labyrinth water), and if the walls of the petrous bone which enclose it are so solid that we can consider them as absolutely so when compared with the minute pressure under consideration, we deduce the following: The communication of action throughout the whole mass is practically instantaneous, and the labyrinth water under the influence of the sound waves moves virtually as a fluid absolutely incompressible (and therefore incapable of sound waves) would move under the same relations."

I am glad that Prof. Bayliss directs attention to the difficulty he finds in seeing how there is a difference of pressure on the upper and lower surfaces of the basilar membrane when the column is a continuous one.

The answer is that the high pressure on the upper side of the membrane is carried through the bent levers of the Corti arches to do mechanical work in bending the hairlets (see p. 138). In science it is true, as in more homely affairs, that we cannot both eat our cake and have it. As the pressure is passed out on the upper side of the membrane to do work in the scala media in bending thousands of hairlets, there is an equivalent loss of pressure in the passage below the membrane. In a double-acting hydraulic engine we have a somewhat similar condition of things. The high-pressure water is admitted into a cylinder and the piston is pushed forward and backward alternately. The piston-rod carries the pressure to the crank-shaft, thus doing external work. The equivalent unit pressure disappears in the exhaust water which is pushed out at atmospheric pressure. The same displacement of liquid takes place in the exhaust, but the displacement is reduced in pressure by the equivalent amount of work carried out of the system.

Prof. Bayliss asks why there are so many Corti arches when a few might suffice. This I take to be necessary in order to extend the surface of excitation, which I have endeavoured to describe on p. 72; also to provide for the probability that during a lifetime of continuous work many of the Corti arches would fail to function.

With regard to Yoshii's experiments, I have not seen them, but Prof. Keith has informed me that such observations have been made, though he did not describe the conditions under which the experiments had been carried out. If the observations depended upon prolonged exposure to the vibrations of a musical note, I scarcely think they should be regarded as a proof of the localisation of certain strings in the basilar membrane to produce certain notes. It might only mean that some weak part in the system gave way and ceased to function under a stress of fatigue. It seems quite possible, as suggested by Prof. Keith, that notes of high frequency, rising very rapidly to their maximum pressure, might tend to short-circuit towards the narrow end of the membrane, and notes of low frequency, rising slowly to their maximum, might impress the wider end of the membrane, but it must be remembered that the areas at the fenestral end are extremely small, and that Helmholtz himself recognised the practically instantaneous action of the pressure throughout the passage.

The strongest argument against the string instrument theory is that in the basilar membrane all the so-called strings are cemented together sideways, and cannot, therefore, vibrate freely or respond each to its own vibration rate.

In the displacement theory the striate or inelastic portion of the membrane moves downwards as a whole, following the same spiral plane on a hinge coinciding with the tapered edge of the aperture, each strip of its breadth descending a distance increasing from the fenestral end to a maximum at the helicotremal end, and in this way obliging the triangular displacements to increase towards that end uniformly.

In a compound-wave form entering the ear we have indications not only of the original impulses of the pure tones from which the compound is built up, but also of the differential tones, the summational tones, and harmonics.

When we find these all reappearing as sensations in the brain, the conclusion appears to be forced upon us that the ear must be a machine adapted to sustain on their passage to the brain these impulses of which we find indications in the wave-form.

My endeavour has been to examine the structure and working of this marvellous machine which causes the accurate transference of such impulses.

THOMAS WRIGHTSON.

Neasham Hall, Darlington.

THE objections against Sir Thomas Wrightson's theory raised by Prof. Bayliss in NATURE of October 17, though grave, no doubt, to those who can appreciate their cogency, yet appear to one who has attempted to approach the problem from the side of phonetics comparatively slight; while there are objections to the prevalent theory which, if I may be allowed briefly to state and develop them, may perhaps throw some light on the question at large.

I would put the matter this way. The human ear as imagined by Helmholtz is no great improvement on Nature, for it could neither (1) hear a note of music, nor (2) hear a large percentage of the words in the English language.

(1) Advancing on the lines laid down by Sir Charles Bell and J. Müller, "that, *however excited*, each nerve of special sense gives rise to its own peculiar sensation" (Bayliss, "Principles of General Physiology," 1915, p. 513), Helmholtz put forward the hypothesis that each fibre of the auditory nerve "hears in its own peculiar pitch" ("Sensations of Tone," 1885, pp. 148 and 151) without regard, as it seems, to the immediate consequences which it must have for his main theory. For, from the rate of damping determined by him, "it follows that the natural pitch of the internal vibrators, which respond sensibly to a given simple sound, ranges over about a whole tone" (Rayleigh, "Theory of Sound," vol. ii., § 389). That means that when a note is sounded a great number of nerve-fibres are stimulated, for the Helmholtz mechanism of the internal ear requires every string of its remarkable pianoforte to be connected "with a nervous fibre in such a way that this fibre would be excited and experience a sensation every time the string vibrated" (p. 129). The number of strings or internal vibrators allotted to the interval of a whole tone varies. In 1870 it was 66⅔; in 1877 it was 100; but the number, if more than one, is immaterial here. Assuming that 100 strings of the basilar membrane vibrate in unison with the given note, 99 of these will be executing forced vibrations at other than their proper frequencies, and *ex hypothesi* 99 nerve-fibres will call up 99 dissonant sensations of tone, all of different pitch and of intensities diminishing regularly on either side of a maximum, which is due to the 100th fibre, the peculiar pitch of which agrees with the exciting note. As each nerve-fibre, *however excited*, gives rise to the sensation of its own peculiar pitch, it matters not whether the internal vibrators vibrate with their proper frequencies or with that of the imposed tone. Unless, therefore, there is in the central organ some contrivance, which Helmholtz does not provide, for inhibiting the odd 99 nerve-fibres, or a transformer of some kind to standardise their pitch, it follows that when a tuning-fork is made to vibrate, no note can be heard, but only an unimaginable din. Music would then be impossible; we could never hear anything but noise.

On the other hand, if Helmholtz had allowed each nerve-fibre to communicate the actual pitch of the vibrator connected with it, whether executing a free or a forced vibration, then there could never be a clean-cut, staccato ending to a note, but after a bass note has ceased externally to the ear there would ensue for about one-tenth of a second, according to his estimate—to the ear an appreciable period of time—a similar confused noise of many mistuned strings; for, by p. 144, "an elastic body set into sympathetic vibration by any tone vibrates sympathetically in the pitch number of the exciting tone; but as soon as the exciting tone ceases, it goes on sounding in the pitch number of its own proper tone." The cochlea (limaçon, Schnecke) well deserves its name. For, however many fibres its house may hold, the snail certainly has two horns. Sir Thomas Wrightson's theory presents us with no such dilemma as this.

(2) In 1916 I found that if I sing to a bass note such a vowel as *oh* or *oo*, and end the note staccato by closing the glottis (the "Glasgow" substitute in speech for occlusive *t* or *k*) while keeping the shape of the mouth unaltered, I hear that the harmonic of the voice which is reinforced by that excellent resonator, the cavity of the mouth, is still audible for a very brief space after the voice has ceased to be heard. From which I infer that the rate of damping in the internal ear is more rapid than that of the body of air in the mouth shaped for certain vowels. But as I do not expect or desire that this inference should be accepted as scientific fact merely on my statement, just as little am I disposed to accept Helmholtz's guess-work as an adequate basis for the calculation which was to have such far-reaching and subversive consequences, overthrowing, for example, the belief of Lagrange and Thomas Young that rapid beats may combine into a sensation of tone. Hence my previous letter (NATURE, May 16, 1918) with a kymograph tracing of the word "utter" intoned at pitch 100 and measured by a tuning-fork of the same pitch. In that tracing it is not a question of a note being reduced to one-tenth of its intensity in the time occupied by 9·5 vibrations, but well within that limit a loud note is reduced to silence. There is the proof that the unchecked estimate which is the very keystone of the Helmholtz theory of audition is wide of the mark.

The complete cessation of sound in "utter" is an essential feature of English and of other languages. It is astonishing that Ellis, the phonetician, never thought of this when translating Helmholtz. That which is *common* to the first *p*, *t*, or *k* in "stop, please," "or not to be," "bookcase," by virtue of which these three "sounds" are classed together as voiceless occlusives, is evidently a shock sensation of the sudden cessation of a sound. How the existence of such a sensation is to be reconciled with any resonance theory of audition has long been a puzzle to me. The very term *resonance* seems out of place in the presence of this phenomenon; and when, on May 17, Sir Thomas Wrightson's book came into my hands, the expression "*dead beat*" in his preface appeared to promise an advance towards the solution of a most complicated problem. W. PERRETT.

University College, London, October 23.

The Society of Civil Servants.

APROPOS of the letter which appeared in NATURE of October 24 on the need for scientific workers to organise themselves, I shall be obliged if you will allow me through your columns to direct the attention of scientific workers in the Government service to the recently founded body, the Society of Civil Servants, which is intended to cover the middle and upper grades of the Service—grades which hitherto have been almost wholly unorganised. By its second rule the objects of the society are defined as "to deal with all matters affecting the Civil Service, and to take such action thereon as may be expedient"—a purview of unlimited range. While the society is constituted on the basis of individual membership, members are encouraged to coalesce into whatever sectional associations—called in the rules "grade groups"—may conveniently and naturally come about. It is these "grade groups" that will consider matters such as salaries and scales of promotion which affect their members solely, the society taking up only wide questions affecting the Civil Service generally.

It is an old saying that "Providence helps those who help themselves." Scientific workers have in the past had just cause to complain of the niggardly treatment that they have experienced at the hands of the State. By organising themselves into "grade groups" of the society, according to the various Departments, those in the State employ will have an opportunity of directing attention to their claim for more generous treatment; but should they fail to take advantage of the present opportunity, they will have no one to blame but themselves if in the future they continue to receive the same neglect as in the past. It is no secret that a scheme for the application of the principles of the Whitley report to the

Civil Service has been drawn up by the Ministry of Labour, and is even now being considered by an Inter-Departmental Committee. The recommendations advocated in that report are based on the fundamental hypothesis that both parties to an industry—the employer and the employed—are well organised. If, therefore, men of science desire to have a voice in framing the conditions under which they work for the State, they must organise themselves, and the sooner the better. A beginning has been made, but only a beginning.

G. F. HERBERT SMITH,
Joint Hon. Sec., *pro tem.*, Society of Civil Servants.

2 Old Queen Street, S.W.1, November 5.

Modern Studies in Schools.

I WAS somewhat surprised to read in NATURE of October 3 a vigorous attack upon the Government Committee on Modern Languages on the ground of its having considered nothing but the interests of trade and diplomacy. I trust this will not deter your readers from examining what is generally considered to be a most valuable report. It is certainly a document which has met with the general approval of modern language teachers and others interested in the subject with which it deals. Against the charge made I may point out that of the nine pages of the section entitled "The Value of Modern Studies," nearly three are devoted to the higher aspects of the subject, while the section on the aims of language teaching in schools begins with the sentence, "Language teaching has, and should have, a disciplinary and educative aim," and the treatment of the subject is based on this text.

Most surprising of all is the view expressed in the article that "the opinions of the Committee on educational methods are astonishingly reactionary." If by "educational methods" is meant—as one supposes must be meant, considering the context—"methods of language teaching," the statement is the exact reverse of the truth. The opinions enunciated are the most advanced which have ever appeared in a document issued by a public authority. The Committee recognises the strong position now held by the "direct method," and discusses its merits critically, yet sympathetically. A whole section is devoted to phonetics, and the need for a good phonetic training for teachers is insisted on. Uniformity in grammatical terminology is recommended. Of our own suggestions for examinations, which are usually considered to be of a moderately advanced character, the report says that they are "good so far as they go, but they do not go far enough." An oral test is recommended in all cases, and free composition, it is considered, should either be substituted for or be additional to translation into the foreign tongue. Finally, it is urged that translation in school "should be practised only so far as it is necessary"—a view which probably many teachers will think unsound, but which none will characterise as reactionary.

G. F. BRIDGE.
Hon. Sec., Modern Language Association.

I CORDIALLY agree that teaching for "bread-winning" is the first duty, but "bread-winning" may be "bread-capturing," and it is this spirit, I am afraid, which pervades the report. But manufacturers to-day are more concerned with production and co-operation than with commerce, and they find the need for a wider knowledge of languages for this service, so I am not surprised that the *questionnaire* met with little response.

The aims and methods set forth in the report are of the standard classical type, and they insist on the study of one or, at most, of two languages taught to a high state of proficiency; but the needs of the times, and the average capacities of boys, demand a less specialised course. The difference is fundamental, as Mr. Bridge will admit. We expected a new method and a new outlook, but we got the old. In our opinion, schools should give boys the opportunity of reading many languages, not excluding the Eastern languages or the languages of Africa, and boys should use the languages for research and discovery. Whether this work is disciplinary or educative is of minor importance; or whether it cultivates taste or judgment. Of minor importance, too, as we think, are the various methods of teaching which are recounted by Mr. Bridge. It is true that these are the things which trouble the minds of many schoolmasters, but with deeper aims the methods would take care of themselves. We expected the Committee would have shown the way to more fundamental changes in method, but it did not do so.

THE WRITER OF THE ARTICLE.

THE MINISTRY OF HEALTH BILL AND AFTER.

SINCE October 17, when most of the newspapers gave prominence to an announcement that the Ministry of Health Bill had been re-cast and submitted to the War Cabinet, possibly because the body named has had other things to think of, nothing has been heard of this measure. Much, however, has been said and written of the Ministry itself, and a certain amount, none of it good, of the Local Government Board, the reason being the extent and severity of the influenza outbreak. If some of the speakers and writers are to be believed, the Board, because its methods are "wooden," or because of its "Poor Law taint," is mainly to blame for the epidemic: if there had been a Ministry in existence, the suggestion is that there most certainly would have been no outbreak.

The persons who make these statements are, many of them, those who are responsible for trying to convince the public that if only a Ministry of Health were formed there would follow an immediate and marked improvement in public health.

That many have listened to promises of this kind and look for something in the nature of a quick change is pathetically true. Unfortunately it is true also that disappointment awaits them. It has never been quite clear why it should have been necessary to exaggerate so much as to the benefits likely to follow the establishment of a Health Ministry. The case for a separate Ministry to co-ordinate health effort and ensure that all branches of hygiene, scientific, practical, and administrative, should have proper recognition and support was always sound, and no good can come of these exaggerations. On the contrary, a great deal of harm may result unless it is recognised at once and generally that it may be long, very long, before signs of improvement become apparent.

It has taken, and may still take, a long time to get a Ministry of Health Bill. It will take time to get the right Minister and to organise the Ministry; and then there is no more than a beginning made. The central organisation is probably the least important part of the health organisation in this country. The most effective portion of the work will have to be done at the periphery, by the local organisations, as it has always been done, or, unfortunately in some cases, left undone.

The problem that faces the first Minister and the new Ministry is the problem of the organisation of the working forces, and when it is attacked it is within the bounds of possibility that the Minister and the Ministry may find that these forces are not distributed throughout the country in a particularly suitable manner. An entirely new method of dividing up the country may very probably have to be devised before anything can be done.

As matters stand at present, health work is distributed most unevenly, for the reason that the necessity for a standard unit has never been recognised. The local authority of each district has been declared to be the sanitary authority; powers and duties in relation to public health have been imposed upon or delegated to it, and that has been the end of it. The size of the area, the population and, more important still, the rateable value and the wealth or poverty of the district have never been taken into account.

The result has been that the work has properly been attended to only in the districts where the means were adequate. The large, prosperous districts did all they possibly could; the small, rich districts did superbly because they were small and because they were rich. In the poorer areas as much as could be afforded was done and more or less was left undone.

Only within the last few years has it been seen that the question of *affording* was one of importance, and that good might result if grants in aid of necessary work were made. The experiment was tried in the case of maternity and child welfare schemes, and the result has been that in practically every area an attempt has been made to cover this work. If the whole of public health work is to be covered in every area, grants in aid of all of it will have to be made. The Minister of Health who recognises this and, having induced the Treasury to see it, gets it put into operation will obtain good results; and if, instead of having a flat rate of grant, he gives a percentage that accords with local needs, he will obtain, in the poorer districts particularly, results still better. If he desires to ensure the best results, in addition to making health work more of a national and less of a purely local charge, he will arrange also for the proper distribution of the work. Most of the larger areas are too large to be effectively worked; many of the smaller areas are too small to be thought worth while working. If possible a standard unit of area and population must be devised, and the need for cutting here and grouping there recognised and put into effect.

This part of the Minister's task will be less easy even than arranging for grants in aid. Vested interests have stood and may still stand, for all that is known, in the way of the formation of the Ministry. Strong as they are, however, they are much less strong than the vested interests that must be overcome if local reorganisation is attempted. Until they are overcome and the nation's work of looking after the health of the nation is properly parcelled out, the best results cannot be expected.

The passing of the Ministry of Health Bill, the discovery of a suitable Minister, and the formation of a sound Ministry may bring satisfaction to many. They will not necessarily bring improvement in the national health; will not necessarily, as many appear to think, bring about a total disappearance of epidemics and a vast and immediate reduction in the amount of disease and the annual death-rate.

Marked improvement will be seen only when the work has been properly organised throughout, when it is recognised that the care of the nation's health is a national business and bound to succeed only if it is properly arranged, properly managed, properly financed, and properly supervised.

A Ministry of Health can, if it will, ensure that these things shall be done; it does not follow that they have been done when the Ministry has been formed.

RACIAL INVESTIGATIONS ON FISHES.

TWO very interesting papers[1] by Dr. Johs. Schmidt deal with the significance to be attached to variation statistics. Taking as his material collections of *Zoarces viviparus*, the viviparous Blenny, from different parts of the North European coasts, Dr. Schmidt makes mathematical analyses of measurements of various selected characters. The paper is tersely and very clearly written in English, and illustrated by numerous simple and adequate charts, and some maps showing the localities sampled. Excellent summaries of the reasoning and conclusions are given in each case.

A "population-analysis" by variation statistics can scarcely resolve any biological problem; it merely arranges the material and suggests lines of experiment. Let there be two fish populations, belonging to the same species, in different seas, which do not interbreed, and let certain measurable characters be chosen for study. Frequency-distributions with respect to each character and locality are made, average values of the selected character are calculated, and the fluctuations, or probable errors, are then found. If the differences observed are greater than the fluctuations, the usual conclusion is that the organisms are differentiated: that they belong to different "races," or elementary species. Dr. Schmidt contends that such a conclusion would, as a rule, be unsound. It may be that repeated sampling of a population gives the same average values for the characters—the same "racial picture"; nevertheless, to speak of a "race" and found it on such evidence

[1] *Comptes rendus des Travaux du Laboratoire de Carlsberg*, 13me vol., liv. 3, 14me vol., No. 1, 1917.

might mean little or nothing. By splitting up a large sample of Blennies into groups representing successive years of age, Dr. Schmidt obtained significantly different average values. By taking average values of a character in a number of mothers, and average values of the same character in a number of their offspring, he again obtained different "racial pictures." Finally, by taking different broods of young from the same mothers and rearing these in different conditions significantly different average values for the characters were again obtained. Character differences are thus both "genotypical" and "phænotypical," in Johannsen's terminology. The "race" is a mixture of "genotypes," pure lines of descent in which there is constancy of value of character, and variational studies only give statistical expressions for these mixtures of genes.

The average racial character is much more the result of the mixture, in various proportions, of genes than due to the environment; nevertheless, the latter may be very important. Thus Dr. Schmidt shows that all the fresh-water eels of Europe are racially the same, the average values of the diagnostic characters being practically identical; this is because the environment is really the same, that of the deep water in the Atlantic, where all those eels are spawned and undergo larval development, fixing certain characters for the rest of the lifetime. But the Blennies are non-migratory fishes, and each locality has its own stock. Selection has therefore operated in helping to produce the differences that variation statistics reveal. The environment also acts directly, as is indicated by the experiments recorded in Dr. Schmidt's second paper, producing significant character differences which need not, of course, be transmissible.

J. J.

CANON ALFRED MERLE NORMAN, F.R.S.

IT has often been remarked that the study of science in this country has been notably advanced by the efforts of those who have never been professionally engaged in it. Canon Norman, who died on October 26, belonged to the best type of this class of scientific worker. His name will be long remembered for the conspicuous service he rendered to the study of the marine Invertebrate fauna of the Atlantic and Arctic areas, and for the special interest he took in deep-sea dredging at the time when the wonders of the abysses were first being revealed. The youngest son of John Norman, D.L., of Iwood, Congresbury, and Claverham House, Yatton, Somerset, he was born at Exeter in 1831, and was educated at Winchester and Christ Church, Oxford, where he took his first degree in 1852.[1] He was ordained deacon in 1856, and priest in 1857. After holding several curacies he was presented to the living of Burnmoor, Co. Durham, in 1866, where he spent nearly thirty years, becoming rector of Houghton-le-Spring, in the same county, in 1895, and rural dean. He was obliged by illness to give up this appointment in 1898, and he soon afterwards settled at Berkhamsted, Herts, where he died. He had become Hon. Canon of Durham Cathedral in 1885.

[1] These personal details have been taken from "Bucks, Beds, and Herts in the Twentieth Century." (Brighton: W. T. Pike and Co.)

When quite a child A. M. Norman was interested in botany by his brother, the Hon. John Paxton Norman, officiating Chief Justice of Bengal, who was assassinated by a fanatic in 1871. At Winchester he studied entomology, and at Oxford he devoted his attention specially to the Mollusca of the county, of which he published an account. While acting as private tutor in the house of the Dowager Countess of Glasgow, at Cumbrae, in 1854-55, he first seriously took up the study of the marine fauna, and from that time he spent nearly all his summer vacations in dredging round the British Isles, Norway, and Madeira, and in the Mediterranean. He thus formed the nucleus of his famous collection of the marine Invertebrates of the Arctic circumpolar seas and of the temperate North Atlantic, together with the inland representatives of the same classes of animals which inhabit the Palæarctic region. This collection was estimated to consist of about 10,000 species and named varieties in 1895. While a large part of it was obtained by himself, many of his choicest treasures were specimens of historical interest which had been purchased or given to him. It was thus extraordinarily rich in type-specimens acquired in these various ways, and it surpassed in importance anything of the same kind existing elsewhere. Before his death Canon Norman transferred it to the British Museum (Natural History), and he presented his almost equally noteworthy collection of books and pamphlets to the zoological departments of the University of Cambridge.

In these days of specialisation the breadth of Canon Norman's interests may well be considered remarkable. It would be difficult to find another modern zoologist able to write with authority on two groups so different as the Polyzoa and the Crustacea, for example. Not only was Dr. Norman an acknowledged authority on both of them, but he was equally well acquainted with others, such as Mollusca, Tunicata, Foraminifera, and sponges. Most of his work was systematic, and a good idea of its general character can be obtained from his papers entitled "A Month on the Trondhjem Fiord," published in 1893 and 1894. It is scarcely necessary to add that he made many additions to the British fauna in many diverse groups, besides describing large numbers of new species.

The remarkable genus Rhabdopleura was dredged by Canon Norman in ninety fathoms off the Shetland Islands and sent to Prof. G. J. Allman, by whom it was described. This organism had no near allies among forms then known, and its affinities were not properly understood until after the discovery by the *Challenger* of Cephalodiscus, a second member of the same group. Another of his specially noteworthy discoveries was the enigmatic encrusting organism obtained by him in the neighbourhood of Madeira, and afterwards named *Merlia normani*, in his honour, by Mr. R. Kirkpatrick. A third genus of remarkable interest which we owe to his enthusiasm is the parasitic Crustacean, Synagoga, belonging to the Ascothoracica, a highly specialised and degenerate subdivision of the Cirripedia.

But it must be emphasised that Canon Norman was much more than a describer of new species and a discoverer of interesting forms. His researches have been of real value in enlarging our knowledge of the marine fauna in general, and few others have contributed more than he did to the faunistic study of the sea.

As one who for many years had the privilege of his friendship I can speak with the most sincere admiration of his genial character, his perfect sincerity, and the high ideals by which he regulated his life. Of his work as a parish priest I am not competent to speak, but I believe that his ministrations were very highly valued by those who came under his influence. Canon Norman was a man of altogether lovable type, and it was impossible to be in his company without feeling the better for it. These characteristics lasted to the end of his life, during the closing years of which he had borne the infirmities of serious illness with an unclouded mind and a fine courage, and without losing the qualities which endeared him to his friends. SIDNEY F. HARMER.

PROF. OLAUS HENRICI, F.R.S.

OLAUS MAGNUS FRIEDRICH ERDMANN HENRICI was born in the year 1840 at Meldorf, on the west coast of Holstein. After leaving the gymnasium at Meldorf at the age of sixteen, he worked in some engineering works at Flensburg. Thence at the age of nineteen he went to the Karlsruhe Polytechnicum, where he had the inestimable advantage of coming under the influence of Clebsch, by whose advice he devoted himself entirely to the study of mathematics. At the age of twenty-two he went to Heidelberg, where he attended Hesse's lectures, and obtained the degree of Ph.D. He then studied under Weierstrass and Kronecker in Berlin. After a short time spent as *Privatdozent* at Kiel, he came to England in 1865.

For four years Henrici worked at engineering problems. During this time he published a little book on skeleton structures (now called pin-jointed structures), and he supplemented his earnings by giving private lessons to schoolboys. In 1870, after a short time spent as assistant to Prof. Hirst at University College, London, he succeeded him in the professorship of pure mathematics, and retained this position for ten years, when he exchanged it for the professorship of applied mathematics. In 1884 he left University College for the professorship of mechanics and mathematics at the Central Technical College, where he entered on a new field of work in the organisation of a laboratory of mechanics, which has been the model of many others, and has had an important influence on the education of English engineers. In 1911 Henrici retired to Chandler's Ford, in Hampshire, where he died on August 10 last.

Henrici was a fellow of the Royal Society, and at one time a member of its council. He was president of the London Mathematical Society for two years, and chairman of Section A of the British Association in 1883. In 1884 the University of St. Andrews conferred upon him the honorary degree of LL.D. He acted as examiner in the University of London from 1875 to 1880, and in this capacity made his influence felt on the introduction of modern methods into the teaching of geometry. In 1877 he married the daughter of the late Rev. Dr. Kennedy and sister of Sir Alexander Kennedy, who survives him. There was one child of the marriage, Major E. O. Henrici, of the Royal Engineers.

Henrici was the author of mathematical papers published in *Crelle's Journal* and the Proceedings of the London Mathematical Society. He contributed several articles to the "Encyclopædia Britannica," amongst which that on "Projective Geometry" stands out as a model of lucidity and form of expression. He wrote jointly with his son a valuable memoir on the theory of measurement by metal tapes and wires in catenary, which made it possible to calculate distances on slopes up to 1 in 3 to an accuracy of one in a million. He was the author of a remarkable little book on "Congruent Figures," in which his ideas of the mode of treating elementary geometry are expounded. It covers in a small compass most of the ground of the first four books of Euclid's "Elements." At one time he purposed to write a sequel to it on "Similar Figures," but it would appear from his address to Section A of the British Association in 1883 that he failed to find a method of treating this part of the subject which entirely satisfied him.

The introduction into English teaching of the methods of vector analysis greatly interested Henrici, but of his ideas there remains in permanent form only what is published in the little book on "Vectors and Rotors" written by his assistant, Mr. G. C. Turner, from notes of his lectures. It deals only with the elementary parts of the subject. The matter contained in this book was to form the earlier portion of a more elaborate treatise. A great amount of manuscript has been left by Henrici, and it is much to be desired that someone will be found to go through it with care and save what is possible of his ideas.

Henrici was greatly interested in the construction of models to illustrate his teaching. One of these, made of rods, showed two confocal hyperboloids connected together so that they could be deformed, always, however, remaining confocal. It had a remarkable history, which he gave in the catalogue of the Exhibition of Mathematical Models at Munich in 1892.

Perhaps the most strikingly original piece of work he did was the invention of the harmonic analyser for representing the equation of a curve in the form of a Fourier series, which he described in the *Philosophical Magazine* for July, 1894.

Henrici will be remembered chiefly as a great teacher. He had learned during his early struggle for a livelihood in London to aim at perfection in form of expression, and he refrained from publishing anything until he felt satisfied as to its form. But for this characteristic we might have had his books on "Similar Figures" and "Vector Analysis."

As one of the large body of Henrici's pupils, the present writer is able to bear testimony to the singular lucidity of his teaching and to his readiness to explain difficulties at all times. With qualities such as these it is easy to understand the mingled respect and affection with which his pupils regarded him. They feel that a great master of his art has passed to his rest.

M. J. M. HILL.

NOTES.

THE epidemic of influenza which has ravaged the country during the last month or so seems to be abating, at least in London, where, however, 1256 deaths were attributed to it in the week ending October 26. The experience of previous epidemics in London has been that excessive mortality from influenza in any single epidemic does not continue beyond a period of about six weeks. Contrary to what has been stated in the public Press, a summer epidemic like that of last July is unusual, and the occurrence of a second epidemic like the present within three months of a previous one is almost unknown. While the influenza bacillus was found only in a small proportion of cases in July, now it seems to be fairly prevalent, but the pneumonia complicating the disease, and to which the mortality is chiefly attributable, appears to be caused mainly by secondary infection with the pneumococcus or the streptococcus. In a small localised influenza epidemic which occurred in a hospital in France Majors Foster and Cookson establish an incubation period of forty-eight hours for the disease, also that infection spreads only within a narrow radius (*Lancet*, November 2, p. 588).

A SCHEME for a national organisation, to be called the Scientific Research Association, to secure a more effective promotion, co-ordination, and endowment of research has been developed recently by a small provisional committee, the acting secretary of which is Mr. A. G. Tansley, F.R.S., Grantchester, Cambridge. The idea is to set up machinery for collecting intelligence as to what is being done and what are the current and prospective needs. Subject committees would act as intelligence bureaux, which would put workers in touch with the best existing facilities for pursuing research in the various branches of science, and at the same time collect information as to current work and needs. This information would be co-ordinated by the council of the association, which would act as an intermediary between the subject committees on one hand, and Government and public bodies disposing of funds available for the endowment of research on the other. The aim of the association would be in no way to interfere with the activities of any existing body, but to co-operate intimately with all bodies and institutions concerned with research, and to act as a co-ordinating agency in all that relates to research. Adherence to the aims of the association has been obtained from a large number of representative men of science throughout the country, and it is hoped to bring the association into relationship with the whole body of research workers in pure science.

THE Lord Mayor of Manchester (Sir Alexander Porter) presided on October 31 at a meeting which he had convened to consider the question of holding an exhibition of British scientific products in Manchester in December and January next. The meeting decided that the proposed exhibition should be held, and that the offer of the City Council to make the building of the College of Technology available for the purpose should be accepted. The proposed exhibition will be similar to that organised by the British Science Guild, which attracted so much attention when it was held recently in King's College, London. Its object will be to show Lancashire people, especially manufacturers and merchants, how many of the products which before the war they were accustomed to obtain from Central Europe are now being manufactured in this country, and how many altogether new products have been invented in Britain since the war began. The exhibition should also give an impetus to the application of science to the industries of Lancashire by showing how much some of these industries, as well as other British industries, owe to the work which British men of science have accomplished during the war. A sufficient sum of money has been guaranteed to cover the necessary expenses of the exhibition. It is hoped that further contributions to the guarantee fund will continue to be received so as to enable the scope of the exhibition to be extended and to include exhibits that will be of special interest to Lancashire. Offers to contribute to the guarantee fund and all other communications relating to the exhibition should be addressed to the Secretary of the Exhibition Committee, College of Technology, Manchester.

WE learn from the *British Medical Journal* that the following resolutions, recently adopted unanimously by the Paris Academy of Sciences of the Institute of France, were unanimously endorsed by the Academy of Medicine on October 15:—(1) The academy, believing personal relations between scientific men of the two groups of belligerents to be impossible until reparation and expiation of the crimes which have put the Central Empires under the ban of mankind permit them again to enter the concert of civilised nations, has adopted the following resolutions:—(2) The Central Empires shall be compelled by a provision of the treaty of peace to retire from international scientific associations established by diplomatic conventions and implying personal relations between the members. This exclusion would not apply to common action solely concerning administrative relations indispensable between such public service as those affecting the regulation of navigation, railways, telegraphs, etc. (3) As soon as circumstances allow, those international conventions not belonging to the two categories noted above shall be denounced by each of the competent groups of the Entente and of the United States of America in accordance with the statutes and regulations of each of them. New associations recognised to be needed for the progress of the sciences and their application shall be established forthwith by the Allies and the United States with the contingent co-operation of neutrals. (4) The Governments of the Allied countries and of the United States shall refrain from sending delegates to any international assembly at which representatives of the Central Empires would be expected to figure. It is desirable that the nationals of the Entente countries and of the United States should adopt the same line of conduct and not take part in any enterprise in which the nationals of the Empires would collaborate. (5) Inquiry should be made as to the steps to be taken to establish intimate collaboration between the Allies and the United States, particularly in the domain of allied science and in the publication of certain bibliographical works.

THE death is announced of Prof. Samuel Wendell Williston, of Chicago, aged sixty-six. Prof. Williston began his career as one of the collectors employed by Prof. O. C. Marsh in the 'seventies to obtain vertebrate fossils from the western territories of the United States. During the winter season he helped Prof. Marsh to prepare the fossils in the Yale University Museum, and at the same time he pursued medical studies which eventually resulted in his graduating as M.D. He was always a keen naturalist, and, being prevented from publishing his observations on palæontology, he turned to dipterous insects, and soon became one of the leading authorities in America on that branch of entomology. Leaving Prof. Marsh in the early 'eighties, Williston was appointed professor of geology and palæontology in the State University of Kansas, at Lawrence, where he established a flourishing school and brought together a great collection of Kansas fossils. Among numerous important papers he wrote especially on the Pterodactyls and the marine reptiles found in the chalk of Kansas. In 1902 Prof. Williston removed to the newly founded chair of palæontology in the University of Chicago, where he not only continued his researches on Cretaceous reptiles, but also collected and investigated the still more interesting Permian reptiles from Texas and Illinois. His writings form no inconsiderable part of the valuable contributions to vertebrate palæontology received from America during the last thirty years, and several of his devoted pupils and associates have followed worthily in his wake.

BY the death on October 23, at ninety years of age, of Mr. Robert Brudenell Carter, consulting ophthalmic surgeon to St. George's Hospital, the medical profession and the public have lost a striking personality. Since the Crimean War to within a few weeks of his death Mr. Brudenell Carter was a constant contributor to the *Times*. On most medical subjects in which the public was directly interested he contributed leading articles, which were always marked by clear language and sound reasoning. He wrote extensively also on hygienic and educational matters. As examples may be mentioned his paper on the constituents of London dust and its effects on health. His conclusions led him to advocate the substitution in our houses of parquet floors for carpets and the abolition, so far as possible, of blinds and curtains—recommendations which he conscientiously carried out in his own house. His pamphlet on "The Artificial Production of Stupidity in Schools" might still be read with profit by our educational authorities. He was always a strenuous opponent of the so-called system of homœopathy, and his correspondence with the late Lord Grimthorpe in the *Times* on this subject will be remembered. With his purely medical writings, which were numerous, this is not the place to deal, but his book entitled "Eyesight Good and Bad," which was written for the general public, may be mentioned. It was a succinct and clear explanation of the physiology of normal vision and of the causes of its common defects. Mr. Brudenell Carter was an active member of the General Medical Council, a body little known to the public, the most important function of which is to protect the public against improper practices by medical men. The writer was privileged to see him on his ninetieth birthday, and found him lying on a sofa, in full possession of his faculties, and although his voice was weak, he discussed freely and with his usual good sense the topics of the day.

THE Christmas course of juvenile lectures at the Royal Institution will be delivered by Prof. D'Arcy Thompson upon the subject of "The Fish of the Sea."

THE FitzPatrick lectures of the Royal College of Physicians of London will be given at the college at 5 o'clock on November 12 and 14 by Dr. Arnold Chaplin. The subject will be "Medicine in England during the Reign of George III."

THE death is announced in the *British Medical Journal* of Dr. F. F. Wesbrook, president of the University of British Columbia, formerly professor of pathology in the University of Manitoba, and professor of public health and bacteriology in the University of Minnesota.

THE death is announced, in his sixty-fourth year, of Prof. William Leslie Hooper, who had been professor of electrical engineering at Tufts College, Massachusetts, since 1890. He had previously been for seven years assistant professor of physics in the same institution. Prof. Hooper was the author of "Electrical Problems," published in 1902.

MAJOR BAIRD, Parliamentary Secretary to the Air Board, announced in the House of Commons on November 3 that the post of Medical Administrator of the Board has been offered to Col. M. H. G. Fell, C.M.G. One of the conditions of the office is that the Administrator will be guided by the principles laid down by the Watson-Cheyne Committee. Col. Fell is at present engaged in visiting stations in this country and abroad, and his answer has not yet been received.

IN the *Times* of October 29 Col. H. A. Haines describes the discovery of a human skeleton with military equipment in a shallow grave in the chalk near Rochester, Kent. The feet of the skeleton were directed eastward, a spear-head lay near the right shoulder, and the boss of a shield was found over the ankles. Another piece of iron occurred behind the waist. Writing in the same newspaper on October 31, Sir Hercules Read points out that the burial may be regarded as that of a Jutish settler in Kent of the fifth or sixth century. The fragment of iron near the waist may have been either a knife or a strike-a-light to be used with a flint.

THE second national reunion of the Argentine Society of Natural Sciences will be held in Mendoza in the spring of 1919. We have just received Nos. 14 to 16 of *Physis*, the society's journal, which shows much activity, especially in entomology and botany. In No. 16 Mr. Carlos Ameghino returns to the subject of fossil man at Miramar, where the numerous implements are supposed to be contemporaneous with the remains of extinct mammals. Among other implements he describes and figures bolas of the modern South American type made of fossil bone. He arrives at the remarkable conclusion that while Europe was still inhabited by men of the Neanderthal race, Argentina was already peopled by advanced tribes of *Homo sapiens*.

THE annual Harveian oration was delivered by Dr. Percy Kidd at the Royal College of Physicians on October 18. The subject was the doctrine of consumption in Harvey's time and to-day. Dr. Kidd surveyed the views of medical writers on phthisis or consumption from the time of Hippocrates. The seventeenth century, which produced Harvey's great work on the circulation, constituted an epoch in the study of consumption, and two names stand out pre-eminently in this connection—Franciscus Sylvius and Richard Morton. The latter had a clear conception of the nature of consumption of the lungs, stated his opinion that the formation of tubercles constitutes the first stage in the phthisical process, and recognised a special scrofulous variety of the disease. Both Sylvius and Morton insisted upon the contagious nature of the affection. The work and views of subsequent investigators were reviewed, and, finally, the recent results of a statistical investigation by Brownlee, indicating that there are at least two types of phthisis, were commented upon.

IN connection with the Sir Walter Raleigh tercentenary, of which we gave an account last week, we are reminded that there is some reason for regarding Raleigh as one of the pioneers of evolution. He was not far from the general idea of transformism. Thus in his "History of the World" (book i., chap. vii.) he says: "For mine owne opinion I find no difference but only in magnitude between the Cat of Europe and the Ounce of India. . . . The common crow and rooke of India is full of red feathers in the droun'd and low islands of Caribana, and the blackbird and thrush hath his feathers mixt with black and carnation in the north parts of Virginia. The Dog-fish of England is the Sharke of the South Ocean." What is suggested is certainly that one kind of animal may have diverse forms in diverse conditions. Raleigh goes on to say that differences in colour and magnitude cannot make "a difference of Species," using the argument that if they did it would be necessary to regard negroes, not as men, but as some kind of strange beasts; "and so the giants of the South America should be of another kind than the people of this part of the World"; and he adds: "We also see it dayly that the nature of fruits are changed by transplantation." It need scarcely be said that Raleigh did not see the transformation of species as Darwin saw it, but the general idea of transformism was surely his.

A COLLISION, when the vessel on which he was returning on leave from West Africa was within three hours' steaming from Holyhead, caused the death, on October 3, of Mr. C. O. Farquharson, mycologist in Nigeria. A graduate in arts and in science of the University of Aberdeen, Mr. Farquharson was a student of the best type, more keen to know thoroughly what he set himself to learn than preoccupied with mere success in examinations. Botany was especially attractive to him, and he proved himself acute and trustworthy in personal investigation of problems in both field and laboratory. He devoted attention to the parasitic fungi, and gladly accepted the position of mycologist in Nigeria. Mr. Farquharson threw himself into the duties with whole-hearted enthusiasm, striving to gain the fullest knowledge of the methods likely to prove helpful in the discovery of the causes and treatment of diseases of economic plants, not confining his attention to those due to fungi. He was also interested in the endeavour to obtain improved races of such plants, whether native or introduced. Moreover, he did good service in the investigation of the botany and entomology of Nigeria, as evinced by a paper on the Myxomycetes of that territory in the *Journal of Botany* in 1916, and by collections and notes on insects communicated to Prof. Poulton. Mr. Farquharson first began to study insects under the influence of Mr. W. A. Lamborn, who, as Government entomologist, became his colleague at Moor Plantation, Ibadan, Southern Nigeria, in May, 1913. After Mr. Lamborn's departure in May, 1914, he corresponded with Prof. Poulton, his last letter being dated August 31, 1918, the day before he sailed in the ill-fated *Burutu*. Mr. Farquharson was a very acute and patient naturalist, who was instinctively drawn to attack the most obscure and difficult problems of bionomics. Many of his valuable observations on insect life, especially on ants and the forms associated with them, are published in the Proceedings of the Entomological Society from December, 1913, onwards, and it is confidently believed that the appearance of his unpublished work will show even more clearly how high were the hopes that perished with him. Mr. Farquharson's character and disposition were such as to win him affection and respect, and his death brings a sense of grievous loss to those who knew him intimately. His place will be difficult to fill. He was in his thirty-first year.

THE Calcutta Mint has overcome the difficulty of supplying metals for coinage during the war owing to increasing demands and recent withdrawals of the old copper pieces. The difficulty of procuring nickel was serious, until it was noticed that the ordnance factories were advertising for sale as scrap large quantities of cupro-nickel derived from used bullets, but contaminated with lead. This metal was utilised in the Mint, and as many as 226 tons of cupro-nickel were used in this way in producing 2,750,000 two-anna nickel pieces issued during the closing months of last year.

IN the Journal of the Royal Anthropological Institute (vol. xlviii., part i., 1918) Prof. H. J. Fleure and Miss L. Winstanley contribute a paper on "Anthropology and our Older Histories." The Irish chronicler Nennius, the "Brut," and Geoffrey of Monmouth are examined in connection with early race movements. The evidence is naturally scrappy and uncertain, but the authors suggest that studies of this kind may be a connecting link between history and anthropology, the distributional examination of place-names being of linguistic value. "Thus archæology and anthropology hint at an unsuspected value of the older and supposedly legendary historians, and suggest that even the chronology of these older historians may have a good deal behind it."

AN interesting case of complete absence of sensations from skin receptors, and of some other special senses, is described in the *Lancet* of October 19. The senses absent are touch, both superficial and deep, pain, heat and cold, muscular sense, taste, and smell. The state has been present for twenty years, but the subject possesses more than the average intelligence. In the absence of guidance from the eyes, he is unable to make any movement as requested, saying that he has no knowledge of whether he is making any movement or not. On the other hand, the more automatic movements of walking and swimming, not requiring conscious co-operation, can be executed correctly without the eyes. It is also clear that the proprioceptive mechanism of the muscles is intact, since, with eyes closed, the limbs can be placed by another person in any position and remain there (Sherrington's "plastic" phenomenon), although the patient is unaware of what position they are in. With visual control, all movements are perfectly normally executed. The subject is ignorant of any feelings of fatigue, and seems to be devoid of most forms of emotion. He has no love of country or of home, and makes neither friends nor enemies. Nevertheless, he is an efficient soldier, and always willing to help in hospital work.

THE annual report of the Department of Fisheries for Bengal and Bihar and Orissa is officially limited to a maximum of eight pages. Mr. Southwell, the Director of Fisheries, gives a short summary of the work of his department, a list of papers relating to marine and fresh-water biology published elsewhere, and a general account of the fishing industry so far as it comes within his cognisance.

THE annual report of the Dove Marine Laboratory at Cullercoats deals with marine biological investigations carried on along the same general lines as in past years. The report on the routine examination of samples of local herrings is interesting in that it suggests changes due to restricted fishing on the East Coast. Up to 1915 the herring shoals were characterised by the predominance of fish of four years of age (that is, herrings with three winter rings on the scales), but in 1916 and 1917 the North-East English shoals contained a majority of five-year-olds. Spawning apparently occurred at the end of August and the beginning of September. Other papers in Prof. Meek's report deal with the growth rates and numbers of ecdyses in Crustacea and with plankton and general faunistic research. Prof. Meek's paper on the growth of Crustacea is noteworthy as an attempt to clear up much that is confusing with regard to this matter.

THE *Fish Trades Gazette* of October 26 contains an interesting article on "Fisheries Reconstruction in Germany," in which the author summarises a memorandum prepared by the Economic Union of the German Deep-sea Fisheries. A great deal is being done in the sphere of technical and scientific research. At Munich "there has been founded a great research institute for the study of the chemistry of food—a direct result of the difficulties from the war—with, in the meantime, a temporary home in the University. It is meant to serve the interests of the whole Empire, and will be richly endowed. A sum of from 3,000,000 to 4,000,000 marks (150,000*l.* to 200,000*l.*) has been set aside for building and equipment, and the annual endowment will be between 100,000 and 200,000 marks (5000*l.* to 10,000*l.*). The director is Prof. Dr. Theodor Paull. . . . In the section dealing with fish it is intended to make researches on the chemical composition and digestibility of fish of every species, fresh and preserved; on the influence of cold and other agents on its preservation and transport; on various methods of preparing fish for the table; and on the so-called 'fish-poison,' or poisoning by bad fish."

Now that ferro-concrete shipbuilding seems to have come to stay, it is interesting to note that, according to *Hansa* for September 14, no composition is necessary to protect ships' hulls from attack by sea-water. This opinion is expressed as the result of several observations on ferro-concrete structures in German harbours.

A FACTORY has been started in Sweden, according to *Teknisk Ukeblad* for August 30, for extracting oil from alum schist. Large quantities of this schist are found in the Lamma Nerika district, yielding benzine and crude oils. The latter can be used for oil-engines or converted into paraffin and lubricating oils. The factory can treat 30,000 tons of schist per annum, giving 1200 tons of oil. The supply of schist in Sweden is practically inexhaustible, and other similar factories will shortly be started.

WATER is decomposed by electric current at the rate of 0·3354 grm. per ampere per hour. The products are 0·416 litre of hydrogen and 0·208 litre of oxygen from the quantity of water named. If, when suitable arrangements for setting up hydraulic pressure have been made, a current be passed through the water, decomposition will take place, and the gases generated will produce pressure of any desired intensity. According to the *Chemiker-Zeitung* (September 4), it is possible to produce pressures as high as 1860 atmospheres in this way.

IN an article in the May and July issues of the *New Zealand Journal of Science and Technology* Mr. M. A. Eliott describes the growth of the frozen-meat industry of New Zealand, and maintains that the demands on it will be still further increased after the war. At the present time about six million sheep and lambs and a quarter of a million cattle are exported per annum, a fleet of fifty properly insulated steamers equipped with refrigerating machinery, and making two and a half journeys per annum, being engaged in the trade. Cold stores have recently been erected in the Colony capable of holding one year's export. The Home Government is alive to the importance of a food supply such as this, and has appointed a Food Investigation Board to deal with the problems arising out of the preservation, storage, and transport of food materials.

PROF. J. T. LUNDBYE, in a paper read recently before the Danish Society of Engineers, gave an account of the various units of light used in European countries, and the intensity of light required for satisfactory illumination under various conditions. A simple method is given (*Ingeniøren,* August 28) for obtaining the intensity of light by measuring the distance at which letters of known size can be read with different lights. Up to a certain point this distance increases very rapidly with the intensity of light, but when the intensity exceeds a certain limit the increase in distance is small. A pair of smoked glasses, which intercept a known quantity of light, and a decimal rule are the only apparatus required. The luminous intensity is found by measuring the distance at which a given specimen of print can be seen through smoked glasses, and then measuring the distance at which it can be seen without them. The ratio between these two operations forms a measure of the luminous intensity.

PROF. KAMMERLINGH ONNES has recently succeeded in demonstrating the possibility of the existence of permanent electric currents without the action of an e.m.f. The resistance of conductors vanishes very suddenly below certain critical temperatures, and a conductor brought to the non-conducting state can carry currents up to a critical value, above which the resistance suddenly reappears. The super-conducting state is not attainable when the conductor is exposed to a magnetic field above a critical value. Tests are described (*Schweizerische Elektrotechnische Zeitschrift,* August 31) in which a current was induced in a lead spiral in its super-conducting state, and continued to flow with a decrease of only 1 per cent. per hour.

IT is common knowledge that the general methods of running boiler plants are not efficient. A good deal of attention has been given recently in the technical Press to the scientific control of steam-raising plants, and the first of a series of articles by Messrs. Brownlie, Compston, and Royse on exact data on the running of steam-boiler plants appears in *Engineering* for November 1. During the past ten years the authors have tested 250 typical steam-boiler plants, comprising 1000 boilers. The present article deals with the efficiency of the economiser. This appliance generally consists of rows of vertical cast-iron pipes placed in the flue between the boilers and the chimney. The feed-water passes through the pipes on its way to the boilers, and takes up some of the heat from the waste furnace gases, which thus reach the base of the chimney at a temperature lower than would otherwise be the case. The exterior surfaces of the tubes are kept clean by scrapers, which travel automatically up and down the tubes. In 155 plants fitted with economisers the average efficiency of the appliance was 11·4 per cent. The possible practical efficiency is 17½ per cent. to 20 per cent. Only 17 per cent. of the plants were saving 15 per cent. or more of the coal-bill, and more than 30 per cent. of the plants were saving less than 10 per cent. The fault does not lie with the economiser as an appliance, but is due to the fact that the economical generation of steam is not understood, and economisers are often not installed on correct lines. The authors estimate that a saving in this country of from 7,000,000 to 10,000,000 tons of coal per annum could be obtained by the use of economisers installed on correct scientific lines.

THE Decimal Association, 212 and 213 Finsbury Pavement House, Finsbury Pavement, London, E.C.2, has published in pamphlet form the article on "The Metric System and Decimal Coinage" contributed by Mr. Harry Allcock to the issue of NATURE for June 6, 1918. It will be remembered that the article was concerned with the attitude towards the metric system of weights and measures and decimal coinage taken by Lord Balfour of Burleigh's Committee on Commercial and Industrial Policy after the War, and it was shown that the decisions arrived at were open to serious criticism.

DR. L. L. FERMOR has pointed out to us, in connection with our notice of his recent paper on hollandite (NATURE, vol. ci., p. 392), that he used the term "bipyramidal" as a synonym for the older "pyramidal" in the paper itself. He also shows that the name "romanéchite" is correctly accented, according to French usage, although derived from the place-name Romanèche, a good analogy being the three words *cher*, *chère*, and *chéri*.

THE LIBRARY PRESS, LTD. (26 Portugal Street, W.C.2), will publish shortly a translation, by B. Miall, of Prof. J. Amar's "The Physiology of Industrial Organisation and the Re-employment of the Disabled." The book is being edited by Prof. A. F. Stanley Kent, who will supply to it an introduction and notes.

OUR ASTRONOMICAL COLUMN.

THE DARK-LINE SPECTRUM OF NOVA AQUILÆ.—Dr. J. Lunt has sent to NATURE some interesting details relating to the transient dark-line spectrum of Nova Aquilæ, as photographed at the Cape Observatory with the McClean spectrograph on June 10, 11, and 12. Apart from the bright and dark hydrogen spectrum which was in process of development, the spectrum was a continuous one crossed by a true absorption spectrum consisting principally of the enhanced lines of titanium, iron, chromium, strontium, calcium, magnesium, and helium. As shown by iron comparison spectra, the entire series of lines was displaced to the violet by an amount representing a radial velocity of 1500 km. per second (June 11 and 12). The violet edges of broad absorption lines, left partially uncovered by broad bright bands, do not appear to be in question, and the displacement is regarded as a true Doppler effect, due to the actual motion of a stellar body possessing an intensely heated atmosphere of metallic vapours. As in the case of other novæ, the fine dark H and K lines appeared nearly in their normal positions, but Dr. Lunt thinks it erroneous to consider their small displacements as representing the velocity of the star; it seems to him more probable that these lines do not originate in the nova itself, but in a nebulous mass lying in the line of sight. The residual incandescent and disturbed nebulous matter left behind after the passage of a rapidly moving star into a nebula would seem to offer a sufficient explanation of the bright-line spectrum. To account for the supposed enormous velocity of the nova, Dr. Lunt suggests that our own system may have a velocity comparable with those found for spiral nebulæ, and that the velocity may result, in part from this motion, and in part from the high velocity of a wandering star which has come from outside our system.

As in Nova Geminorum, there were two sets of dark hydrogen and helium lines during the earlier stages, the first of which showed the same displacement as the enhanced metallic lines. On June 15 the second set had become comparatively narrow and sharp, and showed a displacement equivalent to 2286 km. per second; except for the K line, these have no counterpart in the enhanced line spectrum, and their meaning remains obscure.

OBSERVATIONS OF MINOR PLANETS.—Shortly before the outbreak of war an important international scheme of work on these bodies had been arranged, to secure that all should be sufficiently observed without waste of labour through overlapping. Though the organisation was shattered by war, the observations continue. Marseilles Observatory undertook the circulation of ephemerides and information generally; the recently published *Journal des Observateurs* (vol. ii., No. 9) contains observations of sixty-six planets made during the past year by MM. Gonnessiat and Sy at Algiers Observatory. They include some positions of Juno and Vesta. It is a matter for regret that the Nautical Almanac has discontinued its ephemerides of the four principal asteroids. No predicted positions of them are now available except the approximate ones in the list published annually at Berlin.

A BRIGHT METEOR.—*Astr. Nach.* (No. 4961) contains an account of a bright meteor which fell near Treysa, in Hessen, 9° 10′ E. Gr., 50° 55′ N., on 1916 April 3, 2h. 25m. G.M.T., the sun's altitude being 30° 50′. It was seen over a circle of 135 km. radius, and heard over a circle of 50–60 km. radius, besides a few isolated points at 100 km. distance. The earth-point was calculated, and a prolonged search at length revealed the meteor in a wood. It had made a hole 1·60 metres deep, at an inclination of 60° to the horizon, in a direction from N. 15° W. to S. 15° E., agreeing well with the calculated values. It was composed of iron, and weighed 63 kg. A. Wegener, whose calculations led to its discovery, estimated that its final velocity was in the neighbourhood of 1 or 2 km./sec. The position of the radiant inferred from the observations during flight is 357°+80°, and from the direction of the hole in the ground 20°+78°. The difference is only 5° in great circle.

THE HOT WORKING OF STEEL.

IT is generally held that, in order to obtain the best mechanical properties of which a steel is capable, it is necessary, after having cast it in the form of an ingot, to subject it to a large amount of deformation either by forging or rolling or pressing at a high temperature. Many official specifications, in fact, require a given reduction of the original section of the ingot. These requirements are expressed as "the coefficient of working," which is equivalent to the ratio of the initial to the final section, or, what comes to the same thing, that of the final to the original length. The minimum values assigned to this coefficient are generally three or four, and sometimes higher. Doubts as to the necessity of this, however, have been raised. Prof. Howe, in his treatise "The Metallurgy of Steel," after weighing the evidence on the subject, wrote many years ago that "cumulatively the evidence raises a presumption in favour of the view that the supposed special effect of kneading and pressure, as such, does not exist or is relatively unimportant." Prof. Tchernoff, the eminent Russian metallurgist, has gone even further, and claims to have proved that the effects of forging can be produced by heat treatment alone. In view of the great practical importance of the question, it is somewhat surprising that it has not been made the subject of decisive experiments until quite recently.

Much experimental work is, of course, carried out in metallurgical works which is never published, and from the character of the discussion on M. Charpy's paper entitled "The Influence of Hot Deformation on the Qualities of Steel," presented at the autumn meeting of the Iron and Steel Institute, it would appear that a certain amount of information on this subject is already available. Nevertheless, M. Charpy is entitled to the credit of having been the first in recent years to attempt to obtain an answer to the question with the view of publishing his results and submitting them to discussion.

M. Charpy's experiments may be classified under two heads. In the first place, he attempted to trace the actual character of the deformation when steel ingots are worked either by hot forging or hot rolling. By ingenious methods he was able to show conclusively that in the former the deformation is very far from uniform, that extremely variable local deformations are produced, and that in a given instance, where the mean coefficient of working was 4·8, the extreme values were 2·37 and 7·30. This was one of the simplest cases possible, namely, the transformation of a cylinder into one of smaller diameter; and there can be no question that in a more complicated forging the local deformation would be even more diverse. In the latter case the deformations are very much more regular, and they may be considered as practically uniform. At any rate, lines originally parallel with the axis of rolling were shown to remain rectilinear and parallel during the course of deformation.

In the second place, the author describes certain experiments, designed with great care, to determine the influence of hot working on the properties of the steel. Test pieces prepared from rolled bars, in which the coefficients of working were 1·7, 3·2, and 6·1, were subjected to tensile tests, impact-bend tests, and impact tests on notched bars. The test bars were all cut from the same parts of the ingot, and were situated at one-third of the distance between the surface and the axis so as to avoid the influence of segregation and axial porosities. The bars were quenched and annealed under exactly similar conditions. It was found that the hot rolling of the steel does not appreciably affect the tenacity or elongation either longitudinally or transversely, but that it improves the reduction of area and resistance to impact longitudinally, and considerably diminishes these values transversely. The extent of the variation depends on the quality of the steel, and is more marked the lower its purity. This is a very important result to have established, for it shows that the effects of hot mechanical work must be considered as they affect the properties of the steel both longitudinally and transversely. The author declares that the favourable influence attributed to hot working rests solely on the fact that, in the great majority of cases, only the results of longitudinal tests have been taken into consideration, and that the conclusions arrived at have been unwarrantably extended to materials where the main stress is transverse. His conclusion is that for pieces working under transverse stresses, such as guns, longitudinal extension by hot working has undoubtedly an injurious effect, and that, so far from specifying a minimum reduction of cross-section of the original ingot, it would be much better to reduce it as little as possible. H. C. H. CARPENTER.

EDUCATION AND LIFE.

AMONG the Acts which will make memorable the closing session of the present Parliament none will be held of more momentous import than the Education Act of 1918, limited in its scope to England and Wales; or the scarcely less important measure dealing with Scottish education, which passed its third reading in the House of Commons on October 17. Both measures will have a potent effect on the future education of the two kingdoms, and be fruitful of great results for the educational and physical well-being of the children of the nation. It is therefore to be regretted that Prof. Robert Wallace, professor of agriculture in the University of Edinburgh, should have thought it well to occupy the attention of his students, on the occasion of the opening of the University session on October 8, with a denunciation of the policy of both measures, and that he has now issued and circulated the lecture as a pamphlet (Edinburgh: Oliver and Boyd, price 6*d.*) to Members of Parliament and the Press. Prof. Wallace is apparently persuaded that children between the ages of eight and fourteen should, for their practical instruction, participate actively in agricultural and manufacturing industry on the ground that 85 per cent. of the children of the nation must earn their living by hand-labour, and he would therefore introduce them at a tender and immature age into close intimacy with adults in field, factory, and workshop.

That is not, in the estimation of most thoughtful persons, parents, teachers, and administrators, a desirable policy to pursue in the best and permanent interests of the children and of the nation. Both measures provide not only for a fairly adequate training in literature and in science, but also for effective, practical instruction for both eye and hand, as well as for the physical health and training of the child, and that at just the period of his life when he is most susceptible of treatment and of the permanent effect of such training. Few Acts have been subjected to so large a measure of public discussion as the Education Act of 1918, or have won so general an approval. Its chief purpose, whilst providing for the general well-being of the childhood of the nation, so vital a matter in present circumstances, is to give full opportunity for those who are naturally gifted to share in the highest educational advantages which the nation can offer. Despite Prof. Wallace's strictures, it is demonstrable that the Education Act of 1870 has had a marked effect on the moral health of the nation; for whilst in 1865 70 per 10,000 of the population were convicted of crime, fewer than 30 per 10,000 were so convicted in 1913. And there is abundant testimony, some of which was cited by Mr. Fisher on the introduction of his measure, to the wonderful initiative and intelligent grasp of the young men trained in the elementary schools who, in their scores of thousands, joined the national forces in 1914. The crux of the success of both measures lies with the teachers, who must now, whatever the cost, alike in respect of payment, prospects, and pensions, be attracted to the most vital and worthy of the national services.

THE SCOTTISH JOURNAL OF AGRICULTURE.

THE appearance of an official organ of the Board of Agriculture for Scotland marks an important development in the activity of that body, which, though created but six years ago, has already accomplished much good work in the development and guidance of agriculture and forestry north of the Border. On the educational side of its work it has co-ordinated under its ægis the agricultural colleges and other educational agencies with a success which is noted with warm approval in the report of the Agricultural Sub-Committee of the Reconstruction Committee. Much useful information has also been furnished for the Scottish farmer in the annual reports and leaflets issued by the Board. Its rapidly growing activities rendered inevitable, however, the creation of some more suitable medium of publication of matters of general interest to the agricultural community, and this has been found in the new journal, of which the first three quarterly issues are now available. In appearance and general character the *Journal* is not unlike the older-established *Journal* of the English Board, but the resemblance is little more than superficial, and the design to cater for the specific needs of Scotland is clearly evident throughout.

Original articles of educational value form the most prominent feature, and are supplemented with notes on varied topics of current interest, summaries of official notices and statistics, and a useful review of recent agricultural periodical literature.

The interest aroused in practical circles in Scotland, as in other parts of the kingdom, in the subject of the costs of production of agricultural products is indicated by the inclusion of articles on this subject in each of the three issues, no fewer than four articles dealing with the cost of production of milk alone. Crop production is represented by articles on oats, potatoes, and flax. Other articles selected at random, such as the effects of the war on Scottish forestry, the improvement of hill pasture, the restocking of deer forests, farmers and income tax, rural housing, and women's institutes, illustrate the varied and interesting character of the problems discussed, and incidentally the wide scope of the activities of the Board.

The *Journal* is secure of a hearty welcome from the Scottish agricultural public, and will assuredly in due course be in considerable demand throughout far wider circles of British agriculture as a standard educational publication. C. C.

CHEMISTRY IN EDUCATION AND INDUSTRY.[1]

IN the early eighties of last century the great Livery Companies of the City of London combined for the promotion of technical and scientific education in this country; by reason of their great wealth, the administrative capacity at their command, and their complete freedom from State interference, the City Companies were admirably fitted for this task. Amongst their circle they numbered many men of high scientific and technical standing, such as the late Sir Frederick Abel and Mr. George Matthey, both of whom worked nobly to ensure the success of the new movement. Without describing in more detail the scheme which was adopted, it will suffice to note that the great Livery Companies established and financed, first, the City and Guilds Technical College, and, a year or two later, the larger Central Institution at South Kensington. Both these institutions were designed with the view of popularising scientific and technical education and of counteracting to some extent the overwhelming influence of the older universities; both Oxford and Cambridge, with their glorious history and their scholastic traditions, remained very exclusive, and contributed but little at that time towards the advanced teaching in pure and applied science of which our country stood in urgent need.

We have always been accustomed to attribute importance to aristocracy of birth and family position. This attitude is probably sound; other things being equal, the son of able and influential parents is more likely than another to exhibit ability and a sense of responsibility; we find no cause to revise this opinion in the light of the record of our great families during the last four years. During recent times, however, the conclusion must have thrust itself more and more upon us all that there is another aristocracy, equal in nobility to the first, if not greater—an aristocracy of real achievement and of intellectual attainment. Promotion to this modern aristocracy is slow and painful, but is worth attaining; it can be attained by any young man who possesses the requisite physical and mental equipment. The City Fathers understood this forty or fifty years ago; they realised that one of the greatest needs of the British Empire was the proper utilisation and cultivation of every intellectual talent latent in its children; they believed it desirable that these potentialities should be directed into the wide channels opened by the advance of science and the exploitation of the scientific industries. Acting upon these convictions, they founded our two colleges.

As time went on, the municipal authorities established technical schools and similar institutions broadcast, and the initial striking success of the City and Guilds Colleges waned somewhat under the stress of competition. Although the instinct which guided the Livery Companies in their great scheme of technical instruction was sound, one cannot but think that that instinct played them false at a later date; the closing of the chemical laboratories at the Central Technical College was a real calamity to the nation, as well as a disaster to science. The country needed facilities for still more advanced education and research in applied science—needed them so urgently that the Government has had to provide them at South Kensington. An institution for this purpose established under the auspices of the City Companies could scarcely fail to become really great, whilst under Government administration it incurs some danger of becoming merely colossal.

The scheme initiated by the City and Guilds of London some forty or fifty years ago, having for its object the promotion of scientific and technical education, attracted a number of ardent teachers well known to us all, of whom F. W. Streatfeild was one. With the collaboration of this band of workers the new movement rapidly became fruitful, not only by pouring a host of well-trained workers into the scientific industries of the country, but also by the way in which its very success stimulated other public bodies to emulation, and ultimately provoked intense competition. Since, as we have had to deplore, the original scheme was not raised above this competition by a further spontaneous effort of its initiators, it is only gaining but slowly upon its initial success. At the same time,

[1] From the first Streatfeild Memorial Lecture delivered at the City and Guilds Technical College, Finsbury, on October 17, by Prof. W. J. Pope, F.R.S.

this college remains still flourishing and still fulfilling an essential function amongst the educational institutions of the country.

It is possible to discern roughly three recent periods in the historical development of the teaching and study of pure and applied science in Great Britain. First, the half-century preceding 1914, when progress was comparatively slow owing to the apathy of the general public towards all branches of exact knowledge. During this period our former teachers played a prominent part both as teachers and as propagandists, but progress in our scientific industries was impeded, not only by general and official ignorance, but also by stern competition from the Continent. The second period is one of transition; it embraces the last four years, and is now rapidly coming to an end. In the autumn of 1914 practically all branches of technical production in this country were on the verge of breakdown owing to the sharp arrest of imports of numberless chemical and engineering products, many of them of small financial importance, but all of them essential to our technical production. The whole nation realised, suddenly but tardily, that the neglect of applied science had brought it to the brink of ruin. The last four years of transition have been a period of unprecedented technical activity in Great Britain; during this time we have had to learn how to manufacture multitudes of scientific products which we were previously content to purchase ready-made from abroad, and the whole country has become one vast chemical and engineering workshop. When the history of this time of stress comes to be written it will be made clear that the rapidity and success with which this country has organised its scientific industries and brought them to a production of essentials far exceeding that of Central Europe are entirely miraculous.

The third period, the period of reconstruction, lies in the immediate future, and we see every sign that it will be accompanied by unexampled developments on both the chemical and engineering sides of technical science. During the past four years a vast provision of chemical and engineering equipment has been accumulated; our country has regained control of all the sources existing in the Empire of raw materials which had been previously exploited by Germany, and our people have been learning that this war was rendered possible only by British neglect of applied science, and particularly of chemical technology. Within this period the country has become an enormous producer of such necessary materials as oleum—fuming sulphuric acid—and nitric acid; these are the prime essentials of a flourishing chemical industry. It has also undertaken with success the manufacture of large numbers of fine chemicals, such as coal-tar dyes and pharmaceutical products. The country now produces materials like tungsten and similar metals essential to the manufacture of hardened steels of different kinds for use in cutting-tools, armour-plate, and the like. The installation of works processes for these has been effected hurriedly, and years of careful technical investigation will be needed in order to improve methods and establish processes upon an economical basis. Inasmuch as success in applied science is possible only through the intensive cultivation of pure science, it is to be foreseen that before us lies a period of great scientific and technical activity in Great Britain.

The importance of all this lies in the fact that the future is in your hands. Streatfeild, Castell-Evans, Meldola, Thompson, and Ayrton, who have passed away, and other veterans happily still with us, like Perry and Armstrong, did their best work in the first of our three periods; the men of my generation are expending their energies in the present transitional period. It is upon the students now at college that the main burden of the coming reconstructional work will fall. If you carry out your work with the success achieved by Streatfeild and his colleagues in the performance of their duties, if you approach your future work in the spirit with which my contemporaries have attacked theirs, we need have no doubt that this Empire of ours will continue to influence the world for good long after you and I are dead and forgotten.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The installation of the new Chancellor, Lord Robert Cecil, is to take place on November 12 in the Town Hall. The occasion is to be marked by the conferment of honorary degrees on the French and Italian Ambassadors, Sir George Buchanan, Mr. Austen Chamberlain, Mrs. Fawcett, Sir Maurice Hankey, Lord Moulton, and Lord Phillimore. The following representatives of other universities are also to be present at the ceremony:—Sir Alfred Dale (Vice-Chancellor of Liverpool), Sir Gregory Foster (Provost of University College, London), Prof. Gillespie (Pro-Vice-Chancellor of Leeds), Dr. Alex. Hill (Principal of University College, Southampton), Sir Isambard Owen (Vice-Chancellor of Bristol), and Prof. Ripper (Vice-Chancellor of Sheffield).

LONDON.—The following have been elected deans of faculties for the period 1918–20:—*Medicine:* Sir Bertrand E. Dawson (London Hospital Medical College); *Science:* Prof. A. N. Whitehead (Imperial College, Royal College of Science); *Engineering:* Prof. H. C. H. Carpenter (Imperial College, Royal School of Mines); and *Economics:* The Hon. W. P. Reeves (London School of Economics).

THE nineteenth annual general meeting of the Association of Public School Science Masters will be held on Tuesday, December 31, and Wednesday, January 1, and will be opened with an address by the president, Sir Ronald Ross. The subjects to be discussed are:—The importance of restricting specialisation in university scholarship examinations and giving weight to general education; the modernisation of the teaching of biology; the position of systematic biology and kindred subjects in a school course; science in the general education of boys; the teaching of elementary science by the form master; the difficulty of securing diligence and accuracy in teaching general science to small boys; and courses in general science for Sixth Forms, both classical and non-classical.

TEACHERS of geography will be interested in an account by Miss Christina Krysto entitled "Bringing the World to our Foreign-language Soldiers," published in the August issue of the *National Geographic Magazine*, which describes the methods of teaching at Camp Kearny, California. Ordinary handbooks were found useless for the purpose of teaching the facts of the geography of Europe to Mexican and other foreign recruits. The first step was a series of conversations intended to lead the pupils to the understanding of new facts. These were supplemented by geographical charts with photographs. The comparison of the distinction between the results gained in the case of Italians and Mexicans is full of interest, and will supply useful suggestions for the teaching of geography after the conclusion of the war.

THE current calendar of the Merchant Venturers' Technical College, in which the faculty of engineering of the University of Bristol is provided and maintained, gives particulars of the exemptions accorded to graduates of the University and students of the faculty by various examining bodies and learned societies. The Institution of Civil Engineers recognises the B.Sc. degree with honours in civil or mechanical engineering as exempting from examination for associate membership if a regular course of study, occupying not less than three academic years, has been pursued in the University. The institution also recognises the pass degree as exempting similarly if, in addition to the other conditions, the entrance examination to the engineering course in the University has been passed in the subjects prescribed by the institution. These degrees are also similarly recognised as qualifications for appointments as assistant engineers in the Public Works Departments of India and Egypt. The possession of the B.Sc. degree in civil or mechanical engineering is allowed to count as one year towards the three years' practical training required by candidates for the appointment of Assistant Civil Engineer in the Works Department of the Admiralty. The B.Sc. degree in mechanical engineering exempts from the associate membership examination of the Institution of Mechanical Engineers, and the degree in electrical engineering exempts from examination for the associate membership of the Institution of Electrical Engineers. Finally, the B.Sc. degree, or success in the intermediate examination for that degree, is accepted in lieu of the Army entrance examination.

CERTAIN representative science teachers and others interested in natural science in Yorkshire have decided to form an association with the object of encouraging a broad outlook on scientific problems, and of providing a means whereby they may be kept in touch with modern scientific views. The hearty support given to this proposal from many quarters justifies the view that such a natural science association would be welcome in Yorkshire, and a provisional committee has been appointed to undertake its organisation. Its aims have been formulated as follows:—(1) To afford opportunity for intercourse and co-operation amongst those interested in natural science (chemistry, physics, botany, zoology, and other natural sciences); (2) to discuss the teaching of science in all its bearings; (3) to discuss modern developments in science, and the applications of science in industry; (4) to arrange for visits to places of scientific interest; and (5) to afford a medium for the formulation of collective opinion upon matters affecting the place of science in the life of the community. Membership will be open to all who are interested in the objects of the association, and it is proposed that the subscription shall be 5*s.* per annum. The inaugural general meeting will take place on Saturday, November 23, at 3 p.m., in the University of Leeds, when the president-elect, Prof. W. Bateson, will deliver an address on "Science and Nationality." All who are interested in the movement are cordially invited to be present. Any further information may be obtained from the chairman of the provisional committee, Dr. Harold Wager, the University, Leeds, or from the hon. secretaries, Mr. F. Fairbrother, the Grammar School, Leeds, and Miss R. F. Shove, the University, Leeds.

M. PAUL OTLET has an interesting article on "Le traitement de la littérature scientifique" in the *Revue générale des Sciences* for September 15-30. His claim is that Governments should give more attention to the various methods by which the results of scientific investigation can be made widely known. Among such methods he includes the publication of periodicals, abstracts, annual reports, bibliographies, dictionaries, and text-books. As an example to be followed he quotes the International Institute of Agriculture at Rome. This institute, founded in 1905 by international co-operation, has already an income of 900,000 francs, possesses a library of 70,000 volumes and pamphlets, and receives annually 2600 reviews and journals sent to Rome from the fifty-six co-operating countries. The institute issues three monthly bulletins, two annual volumes of statistics, three other publications appearing once or twice a year, a bibliography of agronomy, and many special monographs. M. Otlet looks forward to the foundation of a similar institute for science, supported by all the Governments of the world, or, at all events, by the Allied Governments. The International Catalogue of Scientific Literature would be a part of this institute, which would also publish abstracts of all scientific papers and periodical *résumés* of work in special branches of science, possess a library to which all scientific periodicals should be sent as they appear, and make arrangements for lending books and papers to subscribers. Finally, M. Otlet asks for an international or inter-Allied investigation into the whole domain of science (pure, applied, economic, and social), including the direction of original research, its application to industries, records of results, scientific literature of all kinds, the teaching of science, and the diffusion of scientific knowledge. The investigation would be followed by a congress with power to make the necessary agreements between the co-operating Governments, and to bring existing associations, institutions, and private undertakings into the general scheme. By such unification of the scientific activities of the world it is hoped to accelerate the progress of science and of its applications.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, October 22.—Dr. A. Smith Woodward, vice-president, in the chair.—Sir E. G. **Loder**, Bart.: Notes on the beavers at Leonardslee, 1916–18. Evidence was given of the hitherto unrecorded fact that beavers may breed twice in a season.—G. A. **Boulenger**: Madagascar frogs of the genus Mantidactylus, Blgr.—Prof. H. M. **Lefroy**: The Wheat Commission on Wheat Weevil in Australia.

MANCHESTER.

Literary and Philosophical Society, October 15.—Mr. W. Thomson, president, in the chair.—J. W. **Jackson**: Discovery of quartz-pebble beds in the Carboniferous Limestone of Caldon Low, Staffs. These pebble-beds form the dip slope of the Low on its N.N.W. side, overlooking Caldon village. At the latter place a large series of fossils, reminiscent of the "Brachiopod beds" of Castleton, etc., has been obtained by Mr. W. E. Alkins. The beds here apparently follow the pebble-beds in true sequence. The two pebble-beds differ greatly in composition, that of Caldon Low being made up almost entirely of rounded pebbles of vein-stone-quartz with fragments of chert, while that of Castleton consists of Carboniferous Limestone pebbles.

SHEFFIELD.

Society of Glass Technology, October 23.—Dr. M. W. Travers in the chair.—Prof. J. W. **Cobb**: Refractory materials and the glass industry. Prof. Cobb emphasised the fact that, although temperatures in glass manufacture were by no means abnormally high, yet the nature of the chemical reactions taking place was such as to render the problem of refractories extremely difficult. There was the corrosive action of the molten glass upon the container to contend with, and, in addition, the corrosive action of hot dust upon flues and furnace interiors. The nature of the various refractory materials used in the glass industry was then dealt with, and the effect of grain size on the refractoriness and strength of silica bricks received thorough treatment. Special emphasis was laid upon the necessity for the smallest joints in building up refractory materials, and furnace building should be regarded from the point of view of masonry rather than from that of bricklaying. The paper closed with a discussion of the evil effects on refractories of penetration of glass and batch materials and the importance of thermal conductivity.—Dr. M. W. **Travers**: The firing of glass pots. By means of a striking collection of specimens the author showed that the life of a glass pot was materially increased if, before filling in, the pot was completely "vitrified." Ways and means of carrying this out were given, and the reason why vitrification before filling gave such good results was fully discussed.—S. N. **Jenkinson**: The requirements of clay for glass-pot making. A brief survey was made of the position of the glass refractories trade, both in 1914 and at the present time, and the necessity for some specification of materials was shown to be urgent. The proposed specification drawn up by the Refractories Committee for clay for pots was then dealt with and its various sections discussed. The question of size, nature, quality, and function of "grog" received full treatment.—Mr. **Coad-Pryor**: Action of certain types of glass upon pots. The author discussed the reason for the quicker solution of the bottom of glass pots as opposed to the sides. Several interesting experiments were described dealing with this problem.—Dr. **Turner** and J. H. **Davidson**: The solubility of pot material in glass. The influence of grain size upon rate of melting was shown.

PARIS.

Academy of Sciences, October 14.—M. P. Painlevé in the chair.—E. **Fournier**: General expressions for the resistance of water to the translation of hulls and their teachings.—E. **Goursat**: The problem of Bäckland.—E. **Cartan**: The varieties of Riemann in three dimensions.—J. **Guillaume**: Observations of Borrelly's comet made with the *coudé* equatorial at the Lyons Observatory. Data for October 1 and 3 are given. On October 1 the comet showed as a nebulosity with undefined edges about 20″ diameter, with a central condensation. Magnitude 10·5 to 11.—M. **Dechevrens**: An electrical tide in the soil derived from the oceanic tide. Observations made at the Saint Louis Observatory, Jersey, between October, 1917, and August, 1918. The gas and water mains connected through a galvanometer gave an e.m.f. of about 0·1 volt, and this has been recorded photographically.—F. **Morvillez**: The conducting apparatus of the leaves of the Saxifrages.—P. **Godin**: Pedagogic interest of the laws of growth.—J. **Amar**: The laws of feminine work and of cerebral activity. The curve of endurance in women is low and undulating, and the physical work amounts to less than 40 per cent. of that of men. It is irregular and lacks continuity.—P. **Duval** and A. **Grigaut**: Intoxication by war wounds.

SYDNEY.

Linnean Society of New South Wales, May 29.—Prof. H. G. Chapman, president, in the chair.—Dr. R. J. **Tillyard**: The Panorpid complex. Part i.: The wing-coupling apparatus, with special reference to the Lepidoptera. The author shows that the most archaic type of wing-coupling apparatus was situated at the base of the wing, and consisted of four parts, two belonging to the forewing and two to the hindwing. These are named (1) on the forewing, the jugal lobe and jugal bristles; (2) on the hindwing, the humeral lobe and the frenulum. These four structures are only preserved in their entirety at the present day in two ancient families of the Mecoptera, the Choristidæ and Nannochoristidæ. The same type occurs in the Planipennia, with the absence of the jugal bristles. The evolution of these structures throughout the other orders of the complex is followed out, the paper dealing finally with the highly specialised types of coupling found in the wings of the Lepidoptera. The Micropterygidæ are shown to possess the archaic jugo-frenate type found in the Planipennia, but with certain specialisations. From the unspecialised jugo-frenate type there are developed in two different directions (1) the true jugate type, found in Hepialidæ and Prototheoridæ, and (2) the true frenate type, found in the other families, though with further specialisation to the amplexiform type in three groups that have lost the frenulum. The author suggests that the Lepidoptera should be divided into two sub-orders, Homoneura and Heteroneura, according to the state of their wing-venation, and that the former sub-order should be again subdivided into two divisions, the Jugo-frenata (Micropterygidæ s. lat.) and the Jugata (Hepialidæ and Prototheoridæ).—Prof. W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales. Part vii.: The geology of the Loomberah district and a portion of the Goonoo Goonoo estate, with two palæontological appendices by F. Chapman. The area in question, containing nearly 100 square miles, lies between the Tamworth district and the Nundle district, described in earlier parts of this series of papers. By the present work, therefore, the detail-mapping of a length of fifty miles of the Great Serpentine Belt is completed, permitting the correlation of the formations throughout. The present area has not been described previously. The points of interest arising in it are chiefly the occurrence of a third fossiliferous limestone zone in the Devonian series, with various important faunal peculiarities; the presence of a remarkable development of the highly albitic intrusive rocks, keratophyres; the abnormal absence of serpentine from the serpentine line; and the presence of dip-faults, breaking across the strike of the Devonian rocks, which may be of Carboniferous origin, but have been planes of movement in post-Permo-Carboniferous times.

July 31.—Prof. H. G. Chapman, president, in the chair.—Prof. W. N. **Benson**: The geology and petrology of the Great Serpentine Belt. Part vii. (continued). Several types of massive igneous rocks have been obtained that were not previously recognised in the Devonian rocks of the Great Serpentine Belt. A very typical example of pillow-structure developed in the spilitic rocks of this region is described and figured. This is the clearest example yet known in Australia.—Dr. R. J. **Tillyard**: Studies in Australian Mecoptera. No. ii.: The wing-venation of *Chorista australis*, Klug. Freshly turned pupæ of this rare Panorpid were obtained by digging and sifting soil in a selected locality. The result is the first study of wing-venation for the order Mecoptera, based on an examination of the pupal wing-tracheation. The pupal wings were dissected off and studied under water in the usual manner. A very remarkable result was obtained. There are only two tracheæ in the wing, one belonging to the costo-radial group and entering the radius, the other belonging to the cubito-anal group and entering the media. Hence the Mecoptera must be regarded as highly specialised in this respect, like the Trichoptera and Diptera, but unlike the Planipennia and Lepidoptera, which retain all their main tracheæ. In the fresh pupa of Chorista the fusions which take place later on between certain veins are not yet accomplished, and hence the imaginal venation can be interpreted with certainty. Use is also made of the distribution of the macrotrichia to determine the limits of Cu_1.—W. W. **L'Estrange** and Dr. R. **Greig-Smith**: The springing of tins of preserved fruit. The blowing of tins containing fruits preserved in syrup appears to be due to the action of yeasts or other gas-forming organisms drawn into the containers through leaks in the joints while cooling after the cooking process. Although various organisms from defective containers were examined, none survived the temperatures to which the contents of containers were subjected during the canning process.

August 28.—Prof. H. G. Chapman, president, in the chair.—Dr. R. J. **Tillyard**: Mesozoic insects of Queensland. No. 3, Odonata and Protodonata. In the order Odonata two new forms are described from the Upper Triassic beds of Ipswich. One of these is placed in the family Lestidæ, forming the sole representative of a new sub-family Triassolestinæ. It shows close affinities with the Epiophlebiinæ, being more or less intermediate between this sub-family and the more reduced types like Synlestes. The other dragon-fly fossil is not placed, being only the tip of a wing, but it has sufficient characters of interest to merit a name. In the order Protodonata a very remarkable new fossil, *Aëroplana mirabilis*, is described, and is made the sole representative of a new suborder Aëroplanoptera. The characters of this extraordinary insect are fully discussed, and a comparison made with Meganeura (Upper Carboniferous of Commentry). From this reasons are given why the insect should be placed in this order, though it stands very far apart from any known type, and might, perhaps, be considered better placed in a new order. A reconstruction of both wings of this fossil is shown in one of the plates.—J. **Mitchell**: The Carboniferous Trilobites of Australia. Of the nine species of Australian Carboniferous Trilobites previously recorded, five only are considered worthy of recognition. Thirteen species of Phillipsia, one of Griffithides, and one of Brachymetopas are described as new.

BOOKS RECEIVED.

Contributions to Embryology. Vol. viii. Nos. 24, 25, and 26. Pp. 198+plates. (Washington: The Carnegie Institution of Washington.)

Winter Botany. By Prof. W. Trelease. Pp. xxxii+394. (Urbana: Prof. W. Trelease.) 2.50 dollars.

The Cambridge Pocket Diary, 1918–19. (Cambridge: At the University Press.) 2s. net.

Reports of the Progress of Applied Chemistry. Vol. ii., 1917. Pp. 536. (London: Society of Chemical Industry.) 6s. 6d.

Alfred Russel Wallace: The Story of a Great Discoverer. By L. T. Hogben. Pp. 64. (London: S.P.C.K.) 2s. net.

A Manual of the Common Invertebrate Animals, Exclusive of Insects. By Prof. H. S. Pratt. Pp. 737. (Chicago: A. C. McClurg and Co.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 7.

ROYAL SOCIETY, at 4.30.—Prof. G. E. Hale: The Nature of Sun-spots.—E. O. Hercus and T. H. Laby: The Thermal Conductivity of Air.—T. K. Chinmayanandam: Haidinger's Rings in Mica.

CHEMICAL SOCIETY, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Tenth Kelvin Lecture—L. B. Atkinson: The Dynamical Theory of Electric Engines.

FRIDAY, NOVEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—H. C. Plummer: The Distribution of the Stars.—Rev. A. L. Cortie: (1) The Spectrum of the Corona, 1914, August 21; (2) The Earlier Spectrum of Nova Aquilæ.—R. J. Pocock: The Relation between Mean Parallax and Magnitude.—H. H. Turner: Note on the Nebulosity round Nova Persei.—R. Watson: Observations of the Light Variation of Nova Aquilæ, 1918.—A. S. Eddington: The Pulsations of a Gaseous Star and the Problem of the Cepheid Variables. Part I.—S. Chapman: The Energy of Magnetic Storms.—Prof. G. E. Hale: The 100-inch Telescope of the Mount Wilson Observatory.—*Probable Paper*: Royal Observatory, Greenwich: Magnitudes of Nova Aquilæ from June 10 to November 1, 1918.

MALACOLOGICAL SOCIETY, at 7.—The Rev. Dr. A. H. Cooke: The Radula of Thais, Drupa, Concholepas, Crouia, Rapana, and the Allied Genera.—W. T. Webster: Notes on the Life-history of *Planorbis corneus* and other Freshwater Mollusca.

PHYSICAL SOCIETY, at 5.—Prof. J. C. McLennan: Low-voltage Arcs in Metallic Vapours.—Dr. W. Wilson: Relativity and Gravitation.—C. R. Gibson: Experiments Illustrating Colour-blindness.

MONDAY, NOVEMBER 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Col. G. S. F. Napier: The Road from Baghdad to Baku.

THURSDAY, NOVEMBER 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—A. Mallock: Sounds produced by Drops falling on Water.—G. H. Hardy and S. Ramanujan: The Coefficients in the Expansions of certain Modular Functions.—Hon. R. J. Strutt: The Light Scattered by Gases; Its Polarisation and Intensity.—Dr. F. Horton and Ann C. Davies.—An Investigation of the Ionising Power of the Positive Ions from a glowing Tantalum Filament in Helium.

OPTICAL SOCIETY, at 8.—T. Smith: Some Generalised Forms of an Optical Equation.—H. S. Ryland: The Manufacture of Binoculars.

FRIDAY, NOVEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—*Adjourned Discussion*: Prof. C. A. Edwards and F. W. Willis: A Law Concerning the Resistance to Penetration of Metals which are Capable of Plastic Deformation, and a New Hardness Scale in Fundamental Units.—R. G. C. Batson: The Value of the Indentation Method in the Determination of Hardness; and Dr. W C. Unwin: The Ludwik Hardness Test.—T. T. Heaton: Electric Welding.

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

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THURSDAY, NOVEMBER 14, 1918.

WAR AND PEACE.

THE turmoil which has shaken the civilised world to its foundations since August, 1914, ceased with the signing of the armistice with Germany on Monday, November 11. A war which was deliberately provoked by advocates of brute force as a quick means of profitable aggrandisement has ended in the triumph of free nations allied against them. Freed from the incubus of the sabre-rattling military aristocracy of Prussia, and from the arrogance of an Emperor obsessed with the lust of conquest, the peoples of the world can again devote themselves to peaceful pursuits. Let us hope that the immoral militarism which led to the war, and sacrificed all principles of faith-keeping, justice, and humanity to attain its purpose, has been vanquished for ever, and that we have seen the last struggle of a system which has dominated a large part of mankind for centuries.

In the early days of the war the Germans attempted to justify their belief in the justice of might by an appeal to the principles of Darwinism. The doctrine of the struggle for existence and the survival of the fittest cannot, however, sanction the ruthless exertion of force and the use of knowledge in the service of egotism and German Kultur. What it should signify is a movement towards higher planes of civilisation and the progressive development of the ethical nature of the human race. Evolution embodies the idea of social ethics, and makes the welfare of the community the essential purpose of the life of the creature. The idea that Darwinism implies nothing more than personal or national mastery at all costs is a crude misconception of this great principle, contrary to the best ends of civilisation.

The execrable deeds of the German land, sea, and air forces cannot be excused by reference to any sound principle of human progress. The spirit represented by such acts as the murder of innocent and unoffending non-combatants, heartless cruelty to women and children, and destruction of priceless buildings, is unworthy of twentieth-century civilisation, and if it had prevailed in the end the sun of righteousness would have set on the world for centuries. Science and scientific principles must not be held responsible for these outward and visible signs of moral degeneration. Chlorine was used as a bleaching-powder for a hundred years before the Germans adopted it as a poison gas. Thermit was employed in the arts before it was used in incendiary bombs. Nitre is a fertiliser as well as a constituent of gunpowder. The search for truth, and the discovery of new substances and forces in Nature, must not be impeded because unworthy use may be made of the results. What has to be done is to advance moral and ethical ideas to higher levels, so that new knowledge shall benefit the human race instead of being used to destroy it. Unless this is accepted, there will be an end of civilisation, for it is possible to conceive of a time when the forces at man's disposal will be so strong that a hostile army or an enemy's city may be destroyed almost at the touch of a button.

The popular mind has associated science and specialised education with German truculence and perfidy, and has even supposed that these conditions are necessarily related to each other. The characters exhibited by Germany in the conduct of the war are not, however, the result of over-cultivation of science, but of a disastrous deficiency in moral and ethical training. The moral sense of a nation requires educating as well as the intellect; and higher civilisation demands that regard for truth and for the sanctity of a promise should be inculcated as being even more important possessions than the knowledge and use of recent discoveries and inventions. The war has shown that spiritual qualities count for much more than mere numbers. Our system of education was inefficient, but it produced a nation of young heroes. As, however, modern war is an affair of applied science—military, engineering, chemical, physical, medical, and economic—it is essential that those who take part in it should be provided with efficient scientific weapons. We have nothing to fear from making science the main axle of the educational coach instead of a fifth wheel, provided only that the right position is given to character training as well.

Though war is not an exact science, and cannot be reduced to a series of mathematical formulæ, tactics are constantly affected by the progress of science, and disaster may ensue if its effect is not correctly appreciated. A nation which lags behind, therefore, in scientific development does so at the cost of a possible loss of supremacy in times of war. Scientific discovery, mechanical invention, and a highly technical organisation, as employed by the Germans, could be beaten only by similar forces arrayed against them. The scientific resources of the British nation were not drawn upon until the formation of the Ministry of Munitions in 1915; and it is these that have provided the country with the scientific material and machinery by which, with similar efforts by our Allies, success has been achieved. If we had not had the chemists to produce the high explosives required, the majority of which are derived from coal-tar products, the noblest spirit would not have saved us from destruction.

When the Germans introduced the use of poisonous gases into warfare, immediate steps were taken by our military authorities to provide the troops with means of protection from them, and action was taken later to organise offensive as well as defensive measures. The matter was put into the hands of men of science, with the result that our gas attacks became more effective than those of our enemies. Sir Douglas Haig said in his despatch at the end of 1916: "The Army owes its thanks to the chemists, physiologists, and physicists of the highest rank, who devoted their energies to enabling us to surpass the enemy in the use of a means of warfare which took the civilised world by surprise."

Science has been successfully called into service in many other directions. The meteorological establishments of the various countries involved in the war have done their utmost to provide greatly increased knowledge of the physics of the atmosphere for the immediate benefit of the armies. Both for naval and military operations, accurate forecasts have been much enhanced in value, and it has been of the highest importance to know the behaviour of the upper atmosphere for the information of the air services, and the condition of the surface atmosphere in relation to gun-sighting and range-finding. The organisation of the medical services for the prevention of disease, as well as the treatment of wounds, has been a veritable triumph. In consequence, the health of the Army has been better in the field than in peace-time, thanks to preventive inoculation, suitable food, and careful sanitation. Typhoid and paratyphoid fevers have been almost unknown, and tetanus has been under complete control. The most gratifying aspect of the whole war is that of the efficiency of the medical services.

Now that the war is practically over, we must prepare to meet other problems. Peace brings with it difficulties to be overcome which rival in magnitude the task of completely vanquishing our enemies. Problems will arise in connection with the health and physique of the nation which will tax the resources of the country's medical services to their utmost limit. The clash of arms will be succeeded by an equally strenuous industrial competition, and the reconstruction of the appalling devastation will call for all the resources of men of science and qualified administrators. We are faced with the necessity for better organisation of science and industry, and more efficient methods of production, if we are to maintain not only our position in the markets of the world, but also our ability to meet the vast expenditure which the war has entailed. It is the duty of men of science to exert themselves to the utmost to secure due recognition and participation of science in the gigantic problems of national and international readjustment with which we are now confronted. In the United States every natural resource, every industry, and every ounce of their great power in money and in men has been made available for the national service for the certain commercial needs of peace no less than for the purposes of war. It is essential for us to make like efforts if we are to secure improvements in the industrial and commercial methods of pre-war days.

Will our people be true to the responsibility placed upon it for the future? If so, it must look to knowledge for its support, and not let itself be cajoled by the platitudes and promises of party politicians. Democracy has hitherto permitted itself to be swayed by eloquence, and has elected to be governed by men of words rather than by men of knowledge and action. The consequence is that men are entrusted with power, not because of any fitness they have shown for the offices they occupy, but because of their political influence or friendships. Scientific and technical experts have been used, but only as hewers of wood and drawers of water, while the administrative control has usually been in the hands of officials with no special qualifications for their directorships.

Much remains to be done by the State and in the city before science and other knowledge are given their full opportunities for increase and service. In originality and capacity of adapting means to ends, the British people is equal to any other in the world, but its attitude towards science is mostly indifferent, and the progress made is nothing compared with what would have been achieved under more stimulating conditions. When a new spirit prevails there will be no end to the rich gifts which science will pour into the lap of the human race. Then, if men are worthy of the fruits showered upon them, there will be an end of the night of weeping, and the advent of the morn of song which is our highest heritage. Let us do what we can to hasten the coming of this time, when men shall stretch out their hands to one another and encircle the world.

SCIENTIFIC UTILISATION OF COAL.

Coal and its Scientific Uses. By Prof. William A. Bone. Pp. xv+491. (London: Longmans, Green, and Co., 1918.) Price 21s. net.

THIS volume, the latest addition to the already vast literature on that protean subject, Coal, is one of particular interest, as it is written from a somewhat novel point of view, the significance of which is scarcely conveyed by the title selected for it; it might have been more appropriately entitled "The Practical Uses of Coal Scientifically Considered," for the author reviews in it the technical applications of coal, whilst, to use his own words, he has "consistently endeavoured throughout to give due prominence to the underlying scientific principles." It need scarcely be said that the work is extremely well done, as might, indeed, be expected from the high reputation that the author has deservedly won in this particular field of labour. Necessarily it contains no really new matter, but gives a clear, accurate, and concise summary of the present state of knowledge regarding the nature and chemical composition of coal, the various changes that it undergoes on heating, and more especially the phenomena associated with its combustion. The use of coal as the source of a wide range of chemical compounds, which form the basis of a vast number of dyes and drugs, is barely touched upon, the author's attention being mainly concentrated upon coal as a source of energy; it is scarcely necessary to add that the utilisation of the by-products that can be simultaneously obtained nevertheless receives due consideration, although the elaboration of these by-products is not followed beyond the earliest stages.

The first third of the volume is taken up with an account of the chemical composition of coal in the light of modern research. Prof. Bone has made good use of the vast mass of material accumulated by previous workers on this subject; it is perhaps to be regretted that the work was completed just before the issue of the important monograph of Drs. Marie Stopes and Wheeler on this subject, so that Prof. Bone did not have the advantage of seeing the most recent views of these writers. Upon the whole, however, Prof. Bone inclines to endorse the views already put forward by Dr. Wheeler in his previous work, whilst admitting that there still remain many obscure points that need to be cleared up. The brief summary of the present state of our knowledge on pp. 126 *et seq.* may be instanced as an excellent example of the author's power of presenting a highly complex subject briefly and lucidly. The next few chapters are devoted to the principles underlying the combustion of coal and their applications to industrial and domestic heating, including the abatement of smoke. Next in order come the carbonisation of coal under various conditions, and the complete gasification of coal for the generation of producer-gas and water-gas. Finally, the important problems of fuel economy in the manufacture of iron and steel, and those connected with the employment of coal for the production of power, are considered. The last chapter is one on surface combustion, which, interesting though it is, does not really fit in well with the general scheme of the book.

In a work covering so wide a range, it is inevitable that all sections cannot be treated as fully as each reader might desire, though it is only fair to point out that the author can scarcely be blamed for this; his difficulty would, indeed, be to compress rather than to expand each portion. Thus it may perhaps be suggested that not enough weight is laid upon direct firing by coal-dust, a method that ought to be capable of the fullest possible utilisation of the thermal energy of the fuel. The possibility of employing the explosive force of a mixture of finely divided coal and air in some form of explosion engine has already occupied seriously the attention of various inventors, and although the difficulties presented are very great, it would be very rash to consider the problem as insoluble. In this way it should be possible to utilise the whole of the mechanical energy developed by the combustion of coal, less, of course, the amount necessarily absorbed in pulverising the coal; if much less is lost in this way than in gasifying coal, the advantages presented are obvious, and it might therefore fairly be suggested that Prof. Bone might have devoted a little more space to the problems affecting the combustion of coal-dust.

One of the most valuable sections of the book is that relating to the possible economies attainable in the manufacture of steel; Prof. Bone is undoubtedly right when he states that the reason why British ironmasters work on less economical lines in this respect than their Continental rivals is because most British ironworks were built at a much earlier date, before modern methods of steel manufacture had been devised, and that it takes time to remodel these older works and to bring them up to modern requirements. British ironmasters have always been fully alive to the need for fuel economy; in this connection it is curious to note that Prof. Bone has overlooked the early experiments of Mr. Charles Cochrane upon drying the blast supplied to the blast-furnace; these long antedated Gayley's work at Pittsburgh, which is fully discussed here.

Taking the book as a whole, Prof. Bone may fairly be congratulated upon having produced a very valuable work upon a very difficult subject, a work which is likely to be of great assistance to every one of the vast army of the industrial users of coal, and to remain a standard work upon the subject for many years to come. H. L.

CATALOGUE OF SCIENTIFIC PAPERS.

Catalogue of Scientific Papers, Fourth Series, (1884–1900). Compiled by the Royal Society of London. Vol. xvi., I–Marbut. Pp. vi+1054. (Cambridge: At the University Press, 1918.) Price 5*l.* 5*s.* net.

WE congratulate the Royal Society on the fourth volume of the Author Catalogue of the scientific papers published during the seventeen years 1884–1900. The first volume (numbered vol. xiii. of the catalogue), containing a list of papers by authors whose names begin with the letters A and B, was published in June, 1914; the second volume, with authors' names from C to Fittig, in February, 1915; and the third volume (numbered vol. xv. of the catalogue), containing the author index to the end of H, in October, 1916. The volume now issued carries the indexing as far as the name Marbut. It is no light matter to have surmounted the difficulties in the production of a work of this magnitude under the conditions created by the war. Scientific workers will also recognise that the Cambridge University Press has carried out the printing with as great care and efficiency as was the case with volumes produced under more favourable conditions.

The earlier volumes were compiled and edited under the able direction of Dr. Herbert McLeod, whose zeal for accurate work is so well known. Since his retirement, in 1915, as director, Dr. McLeod has continued to help with advice as occasion demanded.

The post of chairman of the Committee of Publication was filled by Prof. Silvanus Thompson until his death. It will be agreed that no better chairman could have been found. The interest which Prof. Thompson took in the history of science and of scientific publications made it certain that he would spare no pains in ensuring that the Catalogue of Scientific Papers should be an accurate record.

The Author Catalogue, which has so far been published for names alphabetically arranged from A to Marbut, contains 222,428 titles of papers written by 39,088 authors, an average of about six papers to each author. We may perhaps assume that this number will be doubled before the end of the alphabet is reached. In that case about 450,000 papers will be indexed as published in the seventeen years 1884–1900, or about 27,000 a year. This number is, of course, only an average, being perhaps true for the year 1892. During the last twenty years there has been a great increase in the number of scientific workers and also in the number of journals in which they can publish the results of their researches, so that before the war broke out the annual output of scientific papers must have been at least twice 27,000. Reference to the volumes of the International Catalogue of Scientific Literature shows that in 1913 more than 60,000 scientific papers were published.

We may confidently look forward to the completion of this Author Catalogue. We hope that the Royal Society will also be able to finish the corresponding Subject Catalogue, in which the volumes for mathematics, mechanics, and physics have already appeared. Subject catalogues are so much more useful than author catalogues that it is very important that the publication of the remaining volumes of the series should not be too long delayed.

OUR BOOKSHELF.

A Medical Dictionary. By W. B. Drummond. Pp. ix+625. (London: J. M. Dent and Sons, Ltd., n.d.) Price 10*s.* 6*d.* net.

THIS new "Medical Dictionary" includes much more than its title may suggest, for, in addition to contents bearing closely on strictly medical subjects, we find articles dealing with subjects relating to health, such as athletics, ambulances (with a capital plate of ambulance wagons), cycling, diets, food, and cookery, health resorts, exercise, posture, psycho-analysis, sanitation, ventilation and warming, water supply, and a host of others. We have tested it and have failed to find any omission of moment.

The more special medical sections dealing with diseases give excellent summaries, including causation, symptoms, complications, treatment, and prevention. The principal tropical diseases, such as malaria, sleeping-sickness, cholera, dysentery, sprue, plague, and ankylostomiasis, have brief descriptions allotted to them. Conditions arising in connection with the war have not been omitted, and shell-shock, T.N.T. poisoning, trench-fever, trench-foot, and trench-nephritis are all alluded to. Venereal diseases are briefly dealt with, and their control by the State is discussed. Sections are devoted to anatomy and physiology, and all the commoner drugs are mentioned, their nature and dosage. Under bacteriology we find a brief description of the nature and classification of bacteria, of the part they play in Nature and how they are studied, of the germ-theory of disease, and notes on the principal disease-producing organisms, the whole being illustrated with three text-figures and two full-page plates of photomicrographs. Physical exercises are dealt with and are fully illustrated with four plates. Under drowning Schäfer's method of resuscitation rightly has the foremost place, other methods being also given. Under consumption a good account of the open-air treatment is given, with illustrations.

Sufficient has been said to show the wide and comprehensive scope of this dictionary. The author, Dr. Drummond, is fully alive to the danger of a book of this kind taking the place of the family doctor, and we think he has managed with considerable skill to avoid it. The dictionary should be of the greatest service to the layman as a book of reference on medical and cognate subjects, and to the nurse as a guide in cases of sickness, to the health visitor, minister, missionary, and others. R. T. H.

Medicinal Herbs and Poisonous Plants. By Dr. David Ellis. Pp. xi+179. (London: Blackie and Son, Ltd., 1918.) Price 2*s.* 6*d.* net.

DURING the past three or four years a good deal of interest has been taken in the collection and cultivation of medicinal plants, for the most part by persons who have not enjoyed a botanical training. As a consequence, a desire has been felt for information concerning the properties of medicinal herbs, the uses to which they are put, the means by which they may be identified, their commercial value, and so on. It is for persons thus interested that Dr. Ellis's work is intended; to make it more generally useful he has included certain poisonous plants that are not, or not at present, used medicinally. It may be said at once that his object has been attained. The descriptions of the individual plants are clear and free from undue technicalities; they are accompanied by instructive line-drawings and preceded by two short chapters dealing with the structure of flowers and the physiology of plants.

From a variety of sources the author has collected a considerable amount of information into a small compass, and the lay reader may rely upon finding sufficient information for his purpose concerning our indigenous medicinal and poisonous plants. That inaccuracies occur here and there must be admitted; they appear to be due to insufficient verification on the part of the author, and their presence is not surprising when one considers the number of conflicting statements that have been recently made on the subject. Should a second edition be called for, these might be avoided by submitting the proofs to an expert for critical revision, and blemishes thus be removed from a useful little 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 Colours of the Striæ in Mica.

ON examining even the most regularly split and transparent pieces of mica by diffuse reflected light, a few fine hair-like and rather irregular lines may generally be seen running along the surface. We have found that these lines or striæ show some very interesting effects when mica is examined in a Töpler "Schlieren" apparatus. The sheet as a whole, being optically good, remains invisible, but the striæ shine out as brilliant and vividly coloured lines of light, the colours being different for different striæ, and changing in a remarkable manner as the inclination of the mica relatively to the direction of the light in the apparatus is altered. For instance, a stria at normal incidence may appear crimson and, as the mica is rotated about an axis in its own plane, become successively purple, green, yellowish-green, yellow, orange, scarlet-red, green, yellow, and red.

The phenomenon is being investigated in detail by one of us (P. N. Ghosh), but as to its general nature there appears to be little doubt. The striæ are lines at which the thickness of the mica changes in a discontinuous manner, and the luminosity is due to the radiation from the discontinuity acting as a laminar diffracting boundary. For any particular wave-length the radiation is zero if the retardation of the wave-front on either side of the discontinuity differs by an even multiple of half a wave-length, and is approximately a maximum if the difference is an odd multiple of half a wave-length. The detailed mathematical investigation would follow the general lines indicated by Lord Rayleigh in his theory of the Foucault "knife-edge" test (*Phil. Mag.*, February, 1917).

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PROBABLY the striæ, regarded by the authors as boundaries between regions of slightly different thicknesses, are the same lines as can be seen by reflections of soda light, as described in my note on "Regularity of Structure in Actual Crystals" (*Phil. Mag.*, vol. xix., p. 96, 1910). Doubtless the Foucault method shows them in a more striking manner, and, in any case, the colour effects are novel, so far as I know, and worthy of a closer examination. RAYLEIGH.

SELF-CONTAINED MINE RESCUE APPARATUS.

MOST people are now more or less familiar with the development of the Army respirator from its crude form of a cloth pad to the scientific and efficient "box respirator" used to-day. This is just one example of the many applications and developments of science during the past few years. In mining work the need for the construction of apparatus on scientific lines is being more and more realised, and this is especially so in the case of mine rescue apparatus. When these are employed, whether for actual saving of life, for recovery work after some serious explosion, in dealing with mine fires, or for any other use in an irrespirable atmosphere, it is imperative that the apparatus should be so constructed that the wearer may absolutely rely upon it to last for the period and work required. In the past, unfortunately, too many different types of apparatus have been put on the market without undergoing a thorough and scientific testing, and as a consequence in several cases their use has been attended with fatal results.

The "box respirator" is designed to withdraw, or render innocuous, small quantities of highly toxic gases or vapours, thus leaving the air for the wearer to breathe practically harmless. Certain gases are, however, not readily absorbed by the ordinary form of Army respirator, and of these carbon monoxide is notable. The highly toxic action of small quantities of this gas mixed with air renders the use of an apparatus of the type of a self-contained mine rescue apparatus essential, and for certain classes of work at the Front, where dangerous quantities of carbon monoxide are met with, such apparatus has been largely employed.

The recent report of the Mine Rescue Apparatus Research Committee[1] should prove of interest, therefore, not only to the mining community, but also to many members of his Majesty's Forces. In May, 1917, the Advisory Council for Scientific and Industrial Research appointed Mr. W. Walker (Acting Chief Inspector of Mines), Dr. H. Briggs, and Dr. J. S. Haldane as a Committee "to inquire into the types of breathing apparatus used in coal mines, and by experiment to determine the advantages, limitations, and defects of the special types of apparatus, what improvements in them are possible, whether it is advisable that the types used in mines should be standardised, and to collect evidence bearing on these points."

Recent advance in our knowledge of the physiology of breathing, largely due to the work of Dr. Haldane, and the latter's practical tests on various types of mine rescue apparatus at Doncaster during the past few years, together with those carried out by Dr. Briggs (for the Research Committee) at Edinburgh, have given the Committee a sure foundation upon which to build its report.

[1] First Report of the Mine Rescue Apparatus Research Committee. (Published for the Department of Scientific and Industrial Research by H.M. Stationery Office.) Price 1s. 0d. The illustrations which accompany this article are reproduced from the Report by permission of the Controller of H.M. Stationery Office.

As a result of these and other experimental tests, and of visits to various mine rescue stations throughout the country, the Research Committee is able to make a number of valuable suggestions and recommendations in the first report, with the object of increasing the safety and efficiency of both apparatus and wearer.

In the report attention is directed to the serious defects in existing apparatus, and the lines along which improvement is desired are indicated. Tribute is paid to the pioneer work of Mr. H. A. Fleuss, the designer of the first oxygen mine rescue apparatus. The photo of which Fig. 1 is a reproduction shows Mr. Fleuss and a group of miners equipped with this apparatus, and it is of especial interest in that it records the first application of such apparatus in mining. The photo was taken at the time of the underground fire which followed the explosion at Seaham Colliery, 1880–81. The excellent work of Sir W. E. Garforth (designer of the "Weg" apparatus), Sir John Cadman, and others, in increasing the efficiency of oxygen apparatus, is referred to, and also that of Col. Blackett and Mr. Mills, of Newcastle, in connection with liquid-air apparatus.

FIG. 1.—Henry A. Fleuss and group of miners, equipped with earliest Fleuss apparatus and oxygen lamps. Seaham Colliery, 1881.

Only the so-called two-hour types of apparatus have been dealt with. These may be divided into three classes:—(1) Those in which the oxygen supply is derived from a cylinder of the compressed gas; (2) those in which the oxygen is derived from the evaporation of liquid air; (3) those in which the oxygen supply is produced by the chemical action of water vapour and carbon dioxide on oxylith ($KNaO_3$).

The report shows that the compressed oxygen type is most favoured in this country, there being 1720 apparatus of this type in use compared with ninety-six of the liquid-air type, whilst class 3 has hitherto not been employed here. For those who are not acquainted with mine rescue apparatus a description of a compressed oxygen type may be of interest. The apparatus about to be described is the "Proto" (which is the development of the original Fleuss apparatus). The description is quoted from the report:—

The apparatus has the merit of simplicity. The circulation is dependent on the lungs of the wearer, breathing being entirely through the mouth. The cylinders B together hold 280 litres of oxygen under a pressure of 120 atmospheres. The reducing valve C (Fig. 4), when correctly adjusted, allows a constant flow of oxygen of 2 litres a minute to pass into the breathing circuit. The makers also supply reducing valves, which can be set by the wearer to give discharges ranging from between 0·6 and 3 litres per minute. The oxygen passes through a flexible tube F running over the wearer's left shoulder, and enters the bag at N, where it joins the air being drawn into the lungs. Light mica valves are fitted in the tubes at M and L to control the direction of the flow of the air. The breathing-bag, which is of rubber, is divided into two compartments by a partition reaching nearly to the bottom, and in the bottom of the bag is placed a charge of caustic soda weighing 3 to 5 lb. Either stick-soda is employed or coke nuts coated with caustic. The air, in travelling from one compartment of the bag to the other, has thus to find its way through the soda, and in doing so the carbon dioxide is absorbed. By shaking the bag from to time, new surfaces of the absorbent are exposed to the air, and the absorption of carbon dioxide is facilitated. A saliva trap Z is fitted under the exhaling tube. The pressure gauge, which is carried in a pocket in front of the bag, is connected to the oxygen supply by means of a highly flexible metal tube W. The wearer can thus read his own gauge. A relief valve, operated by the wearer, is placed in the bag at K. Fig. 4 shows how, by means of a strong steel neck, the main valve wheel H is brought to the front within reach of the wearer.

A by-pass short-circuits the reducing valve C. Oxygen can be discharged through the by-pass by opening the cock I. V is the pressure-gauge valve. It is opened only when the gauge is to be read. The weight of the apparatus is about 36 lb. Needless to say, the heavy oxygen cylinders are responsible for the greater proportion of this.

Other types of compressed-oxygen apparatus differ considerably in detail from the "Proto" apparatus just described. For example, in the Draeger (German) and Meco (English) an artificial circulation of air through the apparatus is produced by admitting the oxygen through an injector nozzle at a constant rate, an air circulation of from 50 to 60 litres a minute being thereby induced, independent of the lungs.

Face-masks, in place of the mouthpiece shown in the illustrations of the "Proto" apparatus, are sometimes supplied. Experimental tests on these have shown that they are a source of grave danger to the wearer, when in a poisonous atmosphere. Consequently the Research Committee in its report advocates the complete abolition of such in favour of the mouthpiece. With a "face-mask" or "half-mask," the injector principle, of having a good artificial flow of air always passing the mouth, is essential. Otherwise an excessive amount of carbon dioxide soon accumulates in the mask, with the result that the efficiency of the wearer is seriously affected. Various other minor advantages have been claimed for the injector type, but it has so many dangerous drawbacks that the Research Committee strongly advocates the complete abolition of the injector in any apparatus.

All the main types of apparatus, with their advantages and defects, are discussed at length in the report. The difference in method of purification of the expired air may be referred to briefly here. In the case of most compressed oxygen apparatus the purification is effected by passing through a metal cartridge or purifier containing granulated soda, potash, or both. The expired air thus passes through the purifier before reaching the breathing-bag. Considerable heat is developed by the action of carbon dioxide and moisture upon the regenerating agent, and in the case of the "Proto" apparatus, in which the alkali is actually contained in the breathing-bag itself, the heat produced is not easily dissipated, owing to the non-conducting character of the rubber bag. The temperature of the inspiratory air becomes then, under certain conditions of working, almost unbearable. The trouble, however, with the average cartridge that has been put on the market in the past is that it has been totally inadequate to perform the work claimed for it by the makers, and in consequence lives have in many cases been endangered by the use of such apparatus.

To give an example of an apparatus coming under class 2—*i.e.* where the oxygen supply is derived from liquid air—the description of the "Aerophor" may be quoted from the report. There are quite a number of these apparatus in use in the United Kingdom, and with further research and improvement they should be capable of doing very good work. The "Aerophor" is shown in Figs. 5 and 6.

FIG. 2.—Proto apparatus, front view.

FIG. 3.—Proto apparatus, side view.

The receptacle A, holding the charge of 8 lb. or 10 lb. of liquid air (which in practice always contains more than 60 per cent. of oxygen), is carried together with the purifier U on the wearer's back, while the breathing-bag B is at the front. To prevent the wearer being affected by the extreme cold of the pack, the canvas jacket which supports the apparatus is padded at the back with felt, and an air-space is left between the padding and the pack. At the Northumberland and Durham stations the half-mask is employed, while at the Rotherham station—where the accompanying photographs were taken—the mouthpiece is used. The absorbent material within the metal receptacle is asbestos wool. To charge the apparatus liquid air is poured in from a large Dewar storage bottle into the pack, and a spring balance from which the pack is hung measures the charge. The receptacle is insulated by kieselguhr, felt, and a final cover of leather. The insulation permits the penetration of sufficient heat to volatilise the liquid air at the required rate. During the earlier part of the period of use the volume of volatilised air passing out of the tube from the pack is more than enough to supply the wearer's requirements. The current at this stage divides at J (Fig. 6), one part going to the lungs and the other passing to waste through U (the purifier) and the automatic relief valve R. The exhaled air also discharges through R. Later in the period, when the evaporation is less rapid, the lungs can only get the volume they call for by re-breathing a portion of the exhaled air. The flow in the purifier now reverses; the apparatus becomes a regenerator, and the purifier removes the CO_2 and moisture from that part of the expired air returning to the bag. In the Newcastle model the purifier is larger than that illustrated. An attachment is provided consisting of a length of flexible tube ending in a mouthpiece and relief valve. By connecting this tube to R, it may be possible during the first part of a two hours' interval to supply air to another man. This apparatus, weighing about 30 lb., is somewhat lighter than most of the compressed oxygen types.

The third class of rescue apparatus is unlike any of the others. In this case the oxygen is produced, and the air regenerated, by causing the products of expiration to pass through a cartridge of oxylith (potassium-sodium peroxide). This substance is attacked by carbon dioxide and water vapour with the liberation of about the same volume of oxygen as the carbon dioxide and water contain. The apparatus has hitherto not been successful, owing to its excessive resistance and the heat developed. Its small weight (about 15 lb.) is its chief advantage.

Another interesting point brought out in the report is the necessity for the use of pure oxygen. To the average man it would seem that oxygen showing 90 per cent. of purity should be amply sufficient for breathing purposes. One must remember, however, that in a self-contained apparatus the oxygen is being consumed, whereas the impurities—mainly nitrogen—tend to accumulate. For example, if a "Proto" apparatus is being used in which the oxygen contains 10 per cent. of nitrogen, and the wearer is doing work necessitating the consumption of 2 litres of oxygen per minute—the "blow off" valve not being used—then after about three-quarters of an hour the percentage of nitrogen in the breathing-bag will have increased to about 90 per cent., the oxygen being only 10 per cent. The wearer persisting in his work would quickly become unconscious. The purity of the compressed-oxygen supply is therefore of great importance, and the Research Committee lays stress on the necessity for having every

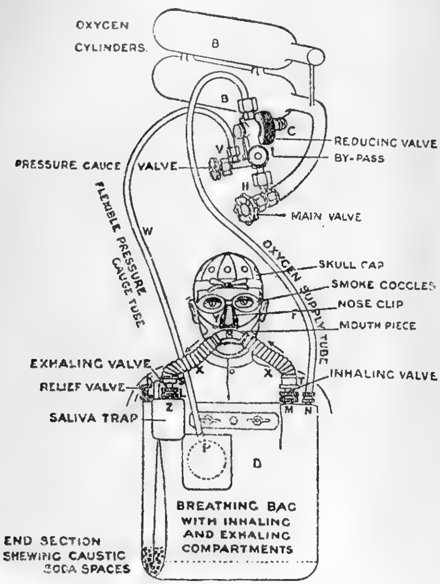

FIG. 4.—Proto apparatus, flow diagram.

FIG. 5.—Aerophor apparatus, front view.

cylinder of oxygen arriving at a rescue station sampled and analysed. It advises, for use *underground*, only such cylinders as contain 98 per cent. or more, and for surface work (practices, etc.) such as contain more than 97 per cent. The danger of hydrogen in electrolytically prepared oxygen is also pointed out.

The Committee recommends the prohibition of the use of any breathing apparatus in mines under the Coal Mines Act unless the apparatus be "of a type for the time being approved by the Secretary of State." The necessity for this is very evident to anyone who has had practical knowledge of the very serious condition in which some apparatus is supplied, and for which the makers are entirely responsible. The Committee also proposes that an inspector should be appointed "to advise the Chief Inspector of Mines as to the safety of these apparatus," and to see that the regulations regarding rescue operations are properly carried out.

FIG. 6.—Aerophor apparatus, back view.

Many other interesting and valuable recommendations are made; the dangers of existing apparatus and means for overcoming these are pointed out, and the training of rescue brigades, methods of signalling, etc., described. The report is most instructive and interesting, and will well repay time spent in its perusal.

In most districts the rescue teams are composed of volunteers from each pit—men who are willing to risk their lives in the work of rescue or recovery in the event of any form of mine disaster. Work in our coal mines at the best is always attended with a certain amount of risk to life and limb. After an explosion or fire this risk is increased considerably. It is only just, therefore, that the construction of the apparatus itself should be such as to involve the least possible risk to the wearer, and that claims made by makers for their apparatus should be capable of complete justification.

The work of the Mine Rescue Apparatus Research Committee and the publication of its reports will be one of the best means of realising this aim.

J. I. G.

INTERCHANGE OF UNIVERSITY STUDENTS.

WHEN in March last Mr. Balfour proposed that a mission consisting of representatives of the universities of the United Kingdom should be sent to the United States, he did the cause of university education notable service. To the members of the conference convened at the Foreign Office, Mr. Balfour described, on the basis of his own recent experience, the influence which university opinion carries in all matters of policy, whether domestic or international, of our great Ally. He then laid emphasis upon the need for the creation by British universities of opportunities of corporate expression. He advocated the establishment of a representative body which would be able to speak for the universities as a whole.

To the conference which had already been called for the next day by the Universities Bureau of the British Empire was remitted the responsibility of selecting a group of men and women to visit the United States. The "Balfour Mission" reached the far side of the Atlantic some two or three weeks ago. Accounts of its proceedings and of the distinguished welcome which the delegates are receiving in all the chief universities of the American continent on both sides of the border have appeared in the papers from time to time.

Acting upon Mr. Balfour's suggestion that our universities should find means of giving expression to their collective views, a Standing Committee, consisting of all their executive heads—vice-chancellors or principals, as the case may be—was appointed by the conference for purposes of consultation and mutual counsel. Whether in constitution this committee remains as at present, or whether in the future some other and more direct method of selecting its members be devised, the universities have, through the delegates whom they sent to the conference, agreed to the institution of "a Senate of the Senates," to use a phrase adopted by Mr. Balfour. They have taken a step which is likely to have a profoundly important effect upon their usefulness and prestige.

One of the main objects of the mission is to promote interchange of students. In the Middle Ages a student was free to migrate from one university to another in search of the most eminent teachers of the faculty of his choice. Like his professors, who had by graduation secured their *jus ubique docendi*, he was matriculated in the universities of the world. The members of the mission will make themselves acquainted with the resources of the universities of America, and reciprocally they will endeavour to make known in America the opportunities for advanced study and research which our own universities afford. The eighteenth-century conception of a university as a glorified public school is to give way to the earlier and sounder view that it is a centre for the creation of knowledge. Made famous by great teachers, one university is especially distinguished in this branch of learning, another in that. A lad is not "finished" as soon as he has been admitted to a degree, whether in Manchester or in Manitoba. He is but fitted to begin to prepare himself to be a leader in his chosen subject. It is scarcely necessary to hint at the encouragement in teaching and stimulus to effort which an enthusiastic worker would derive from the knowledge that it rests with him to lay the foundations of a school which will not merely, as at present, bring undergraduates in increasing numbers to the university which he serves, but will also attract to its walls students from other universities both shortly before and immediately after graduation.

Nor is it necessary to point out that if such opportunities for higher work are to be developed, the universities will need to be supported more generously than they are at present. It is absolutely necessary that departments which show capacity for specialised work should not be limited, or even hampered, by lack of funds. The conception of a university as a place in which all subjects are taught and the claims of all departments equally balanced must give way to the conception that, whereas in every university students are equipped with such elements of education as fit them to tackle their chosen subject with success, each must endeavour to gain a reputation for very special distinction in the subjects which its local situation marks out as its own peculiarly appropriate sphere.

On the other side of the Atlantic migration for purposes of advanced study is already an established habit. Canadian graduates pass to the universities of the United States, and before the war graduates of the United States migrated in large numbers to Europe with the view of studying for two or three years in countries in which the methods of teaching and research, and even the language, are different from their own. A degree which justifies the prefix "Dr." is regarded in America as an indispensable qualification for a higher teaching office. It is looked upon as the recognised symbol of successful post-graduate work. Its title is of little moment. We may not like "Ph.D." The origin of this so-called degree is obscure and almost certainly disreputable, but it has an accepted value. An American who has studied for two or three years after graduation and has done some original work asks for this distinctive label. There is little doubt that British universities will have to concede a similar recognition to their advanced students, whether native or from overseas. Agreement upon the title of the degree is, however, but a detail in the great movement which is now on foot for the fostering of mature and strenuous work. It is obvious that the ablest students must be encouraged to persevere with their studies until they are qualified to undertake work which will make for the advancement of knowledge and its application to human activities of every kind.

If the universities are to be enabled to produce such fruit, their growth needs to be stimulated and strengthened both in material and in *personnel*. Financially they must be placed in a position to keep their equipment in a condition of excellence somewhat in advance of the calls which the moment makes upon them. Their teachers must be encouraged by a sense of opportunity. In whatever part of the kingdom their university home may be, it must be open to them to do something more than earn their pay—not that their pay is as a rule more than adequate remuneration for the routine instruction which they are called upon to give. In the higher work, which naturally interests them most, it is not sufficient that they should have the satisfaction of securing so-and-so many "passed with honours," comforting as such success is and always should be. Nothing would contribute more directly to vitalise their own studies and to stimulate to research than the presence in their classrooms and laboratories of students attracted thither from other universities and especially from universities overseas.

LT.-COL. E. F. HARRISON, R.E., C.M.G.

THE death of Col. Harrison on November 4 deprives the nation of an officer who rendered most magnificent service to the British Army and the Armies of our Allies. The loss is deeply deplored now, closing as it does, at the early period of forty-seven years, a career that gave sure promise of continued high achievement in the coming days of peace. Had it occurred earlier it would have been a calamity to the cause of the Allies that one shrinks from contemplating. But, happily, his great war task was accomplished; his true worth was acknowledged; he had been appointed Controller of Chemical Warfare, and in a few days it would have been known that the quiet, inconspicuous consulting chemist had passed by the force of merit through all the grades from private to Brigadier-General in the Army. Many have helped in the task suddenly imposed upon the Allies by the perfidy of the enemy in inaugurating gas warfare, but it may safely be said that no name should stand out more conspicuously for gratitude and renown than that of Col. Harrison.

Edward Frank Harrison was educated at the United Westminster Schools, and in 1884 was apprenticed to a pharmaceutical chemist in North London. In 1890 he gained the Bell scholarship of the Pharmaceutical Society, and proceeded to its school in Bloomsbury Square. There he was awarded medals and certificates in chemistry, botany, and materia medica, and after passing the minor and major examinations he occupied several positions on the staff, and carried out research on the alkaloids of aconite. While acting afterwards for five years with the firm of Messrs. Brady and Martin at Newcastle, he successfully used his leisure to prepare for the B.Sc. degree of London University. The next six years were spent as head of the analytical department of Messrs. Burroughs Wellcome and Co. In 1905 he went into partnership in a school of pharmacy, but finally took up the independent practice of consulting and analytical chemistry. He was an eminent specialist in the analysis of drugs and medicinal substances, and as analyst to the British Medical Association made nearly all the analyses of proprietary articles which were revealed in the two publications "Secret Remedies" and "More Secret Remedies," a service of immense value to public health and public economy that has scarcely yet, for well-known discreditable reasons, been given a chance of realisation.

Col. Harrison was a fellow of the Institute of Chemistry, and published a number of papers on his special province of the science. His process for estimating the diastatic strength of malts is now in general use. He was active both as a student and a past student in the life of the Pharmaceutical Society's School, in which he was most highly regarded, and to which as his *alma mater* he was loyally devoted. He was a member of the board of examiners, and last year he delivered a thoughtful and valuable address at the inauguration of the session. For three years he conducted the practical chemistry competition maintained in the weekly *Pharmaceutical Journal*. His professional life was, indeed, in the highest degree strenuous.

As soon as the war broke out Col. Harrison was impatient to join the forces. After being refused several times on the ground of age, he became a special constable and a volunteer in the Inns of Court Reserve Corps. Later he succeeded in entering as a private in the Sportsmen's Battalion of the Royal Fusiliers. It was by an accident that he came under the notice of the first head of the anti-gas service at home, Col. Sir W. H. Horrocks, R.A.M.C., who with some difficulty succeeded in securing his services. He was given the rank of lieutenant on the general list, and from that time devoted himself to the anti-gas service. It was only in the present year that his duties were extended over both branches of the gas service. Of Col. Harrison's personal contribution to the invention, design, and manufacture of the appliances necessitated by gas warfare it would not be proper to speak at present in any detail. It is to be hoped that some day the story may be told. It is enough to say that his services were of inestimable value.

The type of chemical training and of experience which Col. Harrison brought to bear was of great value in the design of appliances, on the problem of securing and testing supplies, and of translating laboratory experiment into large-scale operations. This is well brought out in the following extract from a letter which has been received from Lord Moulton: "It is only those who were brought into intimate contact with his work who are able to estimate rightly how great a loss to the country was his death. He was an extraordinary compound of the theoretical and the practical mind. His knowledge of all that bore upon chemical warfare was extensive and profound, but it was accompanied by an overriding practical sense—a sense of proportion—which gave him quick and sound decision and enabled him to give to our armies in the field the full benefit of the researches made by us and our Allies promptly and in the most useful form. I do not see how his place can be filled. I hope, however, that events will show that he lived long enough to finish the work before him. He died at the moment of victory. I fear that his death was due to his having exhausted his strength in his devotion to his country."

Col. Harrison's talent for organisation was, however, dominant above everything. The amount of work he got through was amazing. He was in no way tempestuous or violently masterful, but with indomitable will, intense concentration, and few words he went straight to the heart of things —one thing after another—without confusion, clear-headed, terse, lucid, and suggestive, even when most weary and worn by incessant toil. He was invariably patient and imperturbable; no problem, however suddenly presented or however vast, daunted him, no mischance dismayed him. Emergency seemed to be his natural element; he seemed constantly on active duty. The mention of rest, leisure, or leave raised a smile, as for something incompatible or, perhaps, for the pleasant thought of bygone days.

One could not but wonder what this man might not have done in the arts of peace if only he had been discovered earlier. The war brought him his chance. Suddenly the bonds of an artificial world were released; he put on his armour and fought for four strenuous years, to die an acknowledged leader of men in a vast campaign, and worthy indeed of the full military honours and of the sorrow eloquent on the faces of troops of friends, amid which he was laid to rest. A. S.

NOTES.

INASMUCH as it provides for the bringing together, under one Minister, of the Local Government Board, the Insurance Commissioners, and other bodies performing health duties of a more or less definitely preventive kind, the Ministry of Health Bill will be welcomed by all interested in improving the national health. The welcome, in all probability, will be a little less warm than it might have been, because, though the Bill may, as Dr. Addison, the introducer, said, "represent a common measure of agreement," it nevertheless contains evidence that much in the way of compromise was necessary before agreement was reached. One of the chief signs is the provision with regard to the taking over from the Board of Education of the medical inspection and treatment of school children. This, it is stated, is to come under the Ministry of Health and its Minister only "as and when it is desirable." There is probably no more important piece of health work than this in the whole realm of public health; no more important duty for a Minister of Health who desires to lay a sound foundation for an A1 nation; and many will consider it a misfortune that the new Ministry is to be formed only on condition that the Board of Education is allowed to continue to carry on health functions, in addition to those which it is regarded as being particularly fitted to perform. Because of this separation of work on behalf of children from that done for other sections of the population there will still be overlapping; the hands of the Health Minister will be, to an extent, tied, and there will be unnecessary expenditure of energy and public funds. Another provision in the Bill likely to interfere with the feelings of satisfaction experienced in certain circles is that relating to the formation of "consultative or advisory councils." To a strong Minister they need not prove a source of weakness; may, indeed, be a source of inspiration and strength; and if Sir Auckland Geddes, who has taken over the Presidency of the Local Government Board, becomes the first Minister of the first Ministry of Health, it is certain that there will be at least a strong Minister. More than this, however, there will be a capable Minister, and one who, on account of his medical and administrative training and experience, can quickly grasp the needs of the health situation and himself assist in the solution of the many problems that fall to be dealt with. With him at the head it seems unlikely that the powers of taking over the health functions of the Board of Education will long remain in abeyance, or that the "consultative councils" will have many opportunities, even if they desire to take them, of going over the head of the Ministry.

INFLUENZA in London has caused 4165 deaths during the four weeks ending November 2, the Registrar-General's returns for the several weeks giving the deaths directly attributable to the complaint as 80, 371, 1256, and 2458. Of these 48 per cent. have occurred between the ages twenty and forty-five, whilst below forty-five years the deaths have been 80 per cent. of the total, and above forty-five years only 20 per cent. Comparing the deaths from influenza at the several ages with the deaths from all causes at the corresponding ages, between the ages 0–5 years the percentage of influenza deaths is 34; 5–20 years, 63; 20–45 years, 64; 45–65 years, 32; 65–75 years, 17; and above 75 years, 8 only. In the corresponding four weeks the deaths are for pneumonia 1127, and for bronchitis 481; the percentage of deaths on those from all causes being for influenza 43, pneumonia 12, bronchitis 5. There has been no influenza epidemic half so severe in London during the last seventy-four years—since 1845 at least. Since 1845 there have only been three influenza epidemics with more than 2000 deaths. These are 1891, April 26 to July 18, with 2056 deaths; 1891–92, December 27 to March 26, with 2101 deaths; and 1899–1900, December 3 to May 12, with 2050 deaths. The deaths in London from influenza during the present epidemic are almost as numerous as the total deaths in London from the complaint in the forty-six years from 1845 to 1890, the deaths during that whole period being 4690. In ten epidemics from 1909 to 1917 the total deaths in London were 4329, which shows the exceptional virulence of the present attack.

THE leading resolution adopted by the Inter-Allied Conference on International Scientific Organisations held in London on October 9–11 last (see NATURE for October 17, p. 133) was to the effect that it is desirable that the nations at war with the Central Powers should withdraw from the existing conventions relating to international scientific associations as soon as circumstances permit, and that new associations be established by the nations at war with the Central Powers, with the eventual co-operation of neutral countries. The application of this resolution was left to the consideration of a committee of inquiry which will meet in Paris shortly. Among the subjects referred to the committee of inquiry is the organisation of the publication of bibliographical works in all branches of science. It is felt that the scientific world has hitherto relied too much upon "Centralblätter" and "Jahresberichte" for information upon recent additions to knowledge. These publications quite naturally give undue prominence to work done in Germany, while work published in other countries is not infrequently ignored. It is therefore important that complete abstracts and bibliographies of science should be published in the Allied countries, without regard to any similar works that may be appearing in Germany. It cannot, however, be expected that the income to be derived from the sale of these works of reference will defray the cost of preparation and publication, and it would therefore appear that such work would require Government subsidies. In planning new work the committee should not overlook existing undertakings, such as the International Catalogue of Scientific Literature. It ought to be possible to arrange that work of this magnitude should be continued without a break even though Germany and Austria no longer co-operate in its production.

THE first general meeting of the National Union of Scientific Workers was held on October 27, and was attended by representatives of eleven branches with more than five hundred members. The constitution of the union was determined, subject to slight alterations in redrafting the rules. It was agreed upon by the meeting that the objects of the union should include:—(1) To advance the interests of science—pure and applied—as an essential element in the national life; (2) to regulate the conditions of employment of persons with adequate scientific training and knowledge; and (3) to secure in the interests of national efficiency that all scientific and technical departments in the public service, and all industrial posts involving scientific knowledge, shall be under the direct control of persons having adequate scientific training and knowledge. Special objects deal with obtaining adequate endowment for research and advising as to the administration of such endowment, setting up an employment bureau and a register of trained scientific workers, and obtaining representation on the Whitley industrial councils. An applicant is qualified for membership if he or she has passed the examination leading to a university degree in science, technology, or mathematics, and is engaged at the time of application on work of a required standard, though certain other qualifications are regarded as equivalent to university degrees and admitted in lieu thereof. A resolution was carried unanimously that a special advisory committee should be appointed to deal with questions arising in connection with the promotion of research. At the close of the meeting the officers for the ensuing year were appointed as follows:—*President:* Dr. O. L. Brady (Woolwich). *Secretary:* Mr. H. M. Langton (miscellaneous). *Treasurer:* Mr. T. Smith (National Physical Laboratory). *Executive:* Mr. G. S. Baker, Dr. N. R. Campbell, Dr. C. C. Paterson (N.P.L.), Mr. R. Lobb, Mr. J. W. Whitaker (Woolwich), Dr. H. Jeffreys, Dr. F. Kidd (Cambridge), Dr. C. West (Imperial College), and Dr. A. A. Griffith (Royal Aircraft Establishment). The address of the secretary is Universal Oil Co., Kynochtown, Stanford-le-Hope, Essex.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the ensuing year at the anniversary meeting on November 30:—*President:* Sir Joseph Thomson. *Treasurer:* Sir Alfred Kempe. *Secretaries:* Prof. Arthur Schuster and Mr. W. B. Hardy. *Foreign Secretary:* Prof. W. A. Herdman. *Other Members of the Council:* Sir George T. Beilby, Prof. V. H. Blackman, Mr. C. V. Boys, Sir James J. Dobbie, Sir Frank W. Dyson, Dr. M. O. Forster, Prof. F. W. Gamble, Dr. J. W. L. Glaisher, Sir Richard Glazebrook, Sir Alfred D. Hall, Sir William Leishman, Prof. W. J. Pope, Dr. W. H. R. Rivers, Prof. E. H. Starling, Mr. J. Swinburne, and Prof. W. W. Watts.

THE court of assistants of the Salters' Company has appointed Dr. M. O. Forster, F.R.S., to be the first director of the Salters' Institute of Industrial Chemistry referred to in NATURE of October 24. Since July, 1915, Dr. Forster has been chairman of the technical committee of British Dyes, Ltd., and was, until recently, a member of the board of directors.

IN view of the urgent necessity for incurring certain preliminary expenditure for afforestation purposes, an interim authority has been set up to carry out the necessary work pending the passing of legislation setting up permanent machinery for the purpose. A supplementary estimate of the sum of 100,000*l.* has been made for this authority.

WE regret to learn of the death at Utrecht, on October 21, of Prof. H. E. J. G. du Bois, well known to physicists by his numerous valuable contributions to the knowledge of magnetism and related subjects. Prof. du Bois was just beginning his work in the new Bosscha Laboratory which the Dutch Government had built for him at Utrecht.

THE death of Mr. Edward Bennis is announced in the *Engineer* for November 8. Mr. Bennis was born in 1838, and was educated at the Quaker College of Newtown, in Waterford. He will be remembered for his inventions of mechanical stokers, and for his work in connection with problems of smoke abatement.

ON Wednesday, November 20, the opening address of the 165th session of the Royal Society of Arts will be delivered by Mr. Alan A. Campbell Swinton, chairman of the council. The subject of the address will be "Science and the Future." The chair will be taken at 4.30.

AT the students' meeting of the Institution of Electrical Engineers, to be held on Friday, November 22, at 7 p.m., at King's College, Strand, an address on "The Permeability of Faintly Magnetic Materials," illustrated by experiments, will be given by Prof. Ernest Wilson.

THE following have been elected officers of the Cambridge Philosophical Society for the ensuing session 1918–19:—*President:* Mr. C. T. R. Wilson. *Vice-Presidents:* Dr. Doncaster, Mr. W. H. Mills, and Prof. Marr. *Treasurer:* Prof. Hobson. *Secretaries:* Mr. A. Wood, Mr. G. H. Hardy, and Mr. H. H. Brindley. *New Members of the Council:* Prof. Baker, Prof. Newall, and Dr. Fenton.

DURING the coming session the meetings of the British Association Geophysical Committee will be held on the third Tuesdays of November, January, February, March, May, and June at the Royal Astronomical Society. At the meeting on November 19, at 5 p.m., Mr. R. D Oldham will open a discussion on "The Constitution of the Earth's Interior." The subjects to be dealt with at the January and later meetings will be seiches, seismology, terrestrial magnetism, geodesy, and atmospheric electricity.

AT the anniversary meeting of the Mineralogical Society, held on November 5, the following officers and members of council were elected:—*President:* Sir William P. Beale, Bart. *Vice-Presidents:* Prof. H. L. Bowman and Mr. A. Hutchinson. *Treasurer:* Dr. J. W. Evans. *General Secretary:* Dr. G. T. Prior. *Foreign Secretary:* Prof. W. W. Watts. *Editor of the Journal:* Mr. L. J. Spencer. *Ordinary Members of Council:* Mr. H. Collingridge, Mr. T. Crook, Dr. G. F. Herbert Smith, Dr. H. H. Thomas, Mr. H. F. Collins, Mr. J. P. De Castro, Prof. H. Hilton, Lieut. A. Russell, Dr. A. Holmes, Miss M. W. Porter, Mr. R. H. Rastall, and Sir J. J. H. Teall.

THE council of the Chemical Society has arranged for three lectures, bearing on the ultimate constitution of matter, to be delivered during the present session. The first lecture, entitled "The Conception of the Chemical Element as Enlarged by the Study of Radio-active Change," will be delivered by Prof. F. Soddy at the ordinary scientific meeting to be held at Burlington House on Thursday, December 19, at 8 p.m. Four informal meetings of the society will be held during the present session. The object of these meetings is to give fellows greater facilities for social intercourse than are afforded by the ordinary scientific meetings. The first will be held at Burlington House on Thursday, November 21, at 8 p.m., when the following exhibits will be on view:—Specimens illustrating the manufacture of saccharin (Boots Pure Drug Co., Ltd.), optical glass (Chance Bros. and Co., Ltd., and the Derby Crown Glass Co., Ltd.), tungsten products (Ediswan Electric Co., Ltd.), photographic chemicals (Ilford, Ltd.), fine chemicals (T. Morson and Son, Ltd.), and apparatus (Silica Syndicate, Ltd.).

WE regret to record the death of Sir James William Restler on November 4. Sir James was born in 1851, and was chief engineer to the Metropolitan Water Board. From an account of his career which appears in *Engineering* for November 8, we learn that he completed his education at King's College, London, and received his professional training with the firm of Messrs. John Aird and Sons. In 1883, as chief engineer to the late Southwark and Vauxhall Water Co., he carried out works of considerable magnitude, including the construction of reservoirs having a capacity of 1,750,000,000 gallons, and filter-beds covering twenty-three acres. Sir James designed the Honor Oak reservoir, which was opened in 1909. He frequently gave technical evidence before Royal Commissions and at Parliamentary inquiries. He was a member of council of the Institution of Mechanical Engineers, and had been elected a member of council of the Institution of Civil Engineers for the current session.

PROF. G. BRUNI, of the R. Istituto Tecnico Superiore, Milan, writes to suggest that now the Dardanelles are occupied by British and Allied forces, a monument to the memory of H. G. J. Moseley should be erected at the place where he died. "A call for a subscription to this end would be enthusiastically answered, not only in Great Britain, but also through all the Allied countries." While fully appreciating Prof. Bruni's suggestion, some of Moseley's friends are not much in favour of the erection of a monument at such a distant and inaccessible place. No doubt inclusive memorials will be erected by the various Governments to those who fell at the Dardanelles, and it would be a little invidious to pick out one of so many brave men for special recognition. What would be most suitable would be for the Royal Society or some other body to name a research-scholarship in Moseley's honour, and it is to be hoped that ultimately something in this direction will be done. We understand that as soon as his friends on active service return to this country a Moseley memorial meeting will be held in the laboratory where he did his great research, with the view of erecting a tablet there, though this is not exactly the type of memorial which Prof. Bruni has in mind.

THE *Times* publishes an official report from Capt. Amundsen to the Norwegian Consul-General at Archangel, sent from Dickson Island by wireless telegraph on September 4. The *Maud* took a week to cross the Kara Sea, which in August was impeded with heavy ice, but Capt. Amundsen reports that, so far as he could judge, the ice conditions north of Siberia seem to be favourable. The beginning of September is rather late to pass Dickson Island, but Dr. F. Nansen, in an interview with the *Times* correspondent, expresses the hope that the expedition passed the New Siberia Islands early in November. In this case the ship should by now be beset in the pack and have begun her transpolar drift. Capt. Amundsen, however, has a difficult coast to navigate. He may quite possibly have been caught west of the Taimir Peninsula, and have had to seek winter quarters on the coast. The coast in the vicinity of the Nordenskjold Archipelago affords several suitable harbours. Nansen in August, 1893, and Vilkitski in September, 1914, had difficulties with ice in this region. Even if Cape Chelyuskin is safely rounded, heavy ice may possibly be found between that cape and the Lena delta—a region which has a bad reputation. Possibly in that case Capt. Amundsen will attempt to winter in the little-known Nicholas Land. The expedition reports having fifteen sledge-dogs on board, and to have loaded 105 barrels of oil at Dickson Island.

IN *Mind* (n.s., Nos. 107 and 108) W. M. Thorburn discusses the rights and wrongs of a person in language which is more vehement and impelling than is usual in philosophical papers. He contends that, in spite of the teaching of astronomers and biologists, men will persist in looking upon the "bimanous biped" as the apex of all creation, the highest possible evolutionary form, and, as a corollary, estimate the life of any man as of more intrinsic value than the life of any animal. The quantity and not the quality of the human species is too commonly taken as the ideal. The result is a maudlin sentimentality which fears to face the problem of retribution as the necessary result of wrong-doing, and a futile belief that, by an adjustment of environment, equality among men can be maintained—a belief which is disproved by all the analogies of Nature and the lessons of history. Science is the fruit of leisure, and men of science can have the necessary leisure only if others less gifted are prepared to undertake work which is often called menial. The author's conclusion is a plea to consider whither democracy is leading. The whole discussion is provocative and stimulating, supported by a wealth of literary and scientific allusion, and will be valuable to thinkers in many fields of activity from speculative philosophy to the most practical science. Many will disagree with his conclusions, but his point of view is one which ought to be realised and honestly faced.

IN the *Journal of Hellenic Studies* (vol. xxxviii., for 1918) Prof. Percy Gardner publishes an account of a valuable addition to the Ashmolean Museum in the shape of a female marble figure of great beauty, which lay unnoticed at Deepdene, and was purchased at the sale of the Hope collection in July last. It is not a mere portrait, but a portrait of a woman in the guise of deity, women in Greece being seldom honoured with a statue unless they were more or less deified. It dates from the period 460–440 B.C., corresponding with the active period of Pheidias, and there is good reason to believe that it is a portrait of Aspasia as Aphrodite, and it may account for the accusation of impiety which we know to have been brought against her. The article is fully illustrated by examples of the same type, and the Ashmolean Museum is to be congratulated on an acquisition of singular interest and value.

THE Sultanieh Geographical Society, Cairo, has recently published an attractive programme of its future operations. It proposes to undertake an ethnographic and geographical survey of Egypt, the results of which will be published in periodical bulletins and memoirs; to provide for lectures, a museum, and the conservation of archives connected with this work. The special subjects to which attention will be directed are a monographic survey of the Siva oasis, an outpost of Egypt which has been little studied; an examination of the three groups of Egyptian gipsies—the Beledi, Ghagar, and Nawar—of whom little is known; a study of irrigating devices, with comparison of ancient models; and basket-making. On these subjects monographs will be prepared, and documents, sketches, and photographs collected. The society is undertaking a valuable work which deserves the support of anthropologists.

THE *Indian Journal of Medical Research* for July (vol. vi., No. 1) contains an excellent summary by Lt.-Col. Clayton Lane on methods, old and new, for the detection of hook-worm (ankylostome) infection. Concentration of the ova of the parasite in the dejecta may be effected by straining and centrifuging, and also by a "levitation" method. In the latter the centrifuged deposit is placed on a slide in a little water and allowed to stand for five minutes. At the end of this time the slide is carefully immersed in water and then taken out. By this procedure particulate matter is largely removed, but the hook-worm ova are sticky and adhere to the slide. The exact technique is described, and the method is applicable for parasitic ova other than those of the hook-worm.

A BRIEF summary of the present position of the kelp industry appears in *California Fish and Game* (vol. iv., No. 3). In 1910 the Bureau of Soils of the United States proposed to exploit the vast beds of giant kelp, fringing much of the west coast of America, for the purpose of using these plants for the manufacture of potash and other fertilisers; and the scheme has proved a most fruitful one. The commonest of these plants is the ribbon-kelp (*Macrocystis pyrifera*), which forms enormous beds, usually in places where there is pronounced wave action. The beds of Macrocystis with which the Californian kelp industry is concerned extend from San Diego to Point Conception, and they have been divided up and rented to various companies, which last year harvested nearly 400,000 tons of kelp. It has been found necessary periodically to close the beds for recuperation after harvesting, and to regulate the time of cutting in order that the beaches should not be interfered with during the summer months, nor with unprotected beaches during the winter. From observations so far made, there is no evidence that the fishing industry is in any way injured by this removal of the terminal fronds of the weed, though adjustments are found to be necessary to prevent friction between kelp-harvesters and fishermen desiring to use the beds at the same time.

ATTENTION may be directed to a paper on the anatomy of the potato plant, with special reference to the ontogeny of the vascular system, by E. F. Artschwager, published in vol. xiv., No. 6, of the *Journal of Agricultural Research*. The study was undertaken primarily to serve as a basis for work on that obscure disease—or group of diseases, possibly—to which the name "leaf-roll" has been given; and there can be no doubt that a serious scientific investigation of the nature and causes of this trouble is one of pressing importance for all countries where the potato is grown. The paper referred to will be found very useful as a convenient summary of previous work on the anatomy of the potato plant, and in some directions it throws new light on points which were formerly not altogether clear. The importance of the development of secondary phloëm is emphasised, and it is shown that the increase in size of the tuber is due more to the formation of new tissue in the perimedullary zone than to growth of the pith, as was formerly supposed. It is clearly shown that the skin of the tuber is composed of periderm derived to some extent from the original epidermis, as well as from the hypoderm. The paper is illustrated by twenty-one plates of excellent photomicrographs, as well as by a few text-figures.

IN the Journal of the Washington Academy of Sciences for October 4 Messrs. P. D. Foote and T. R. Harrison, of the Bureau of Standards, in a paper on some peculiar thermo-electric effects, point out that the production of a thermo-electric current in a homogeneous wire by heating it unsymmetrically was known to Franklin and Cavendish a hundred and fifty years ago. It continues to be "rediscovered" once a decade, but up to the present time not one of the many causes which have been suggested for the effect has proved satisfactory. The authors state, however, that in the special form of the experiment in which a hot and a cold piece of the same metal are brought into contact, the direction of the current generated is connected with the sign of the Kelvin effect in the metal.

MR. L. B. ATKINSON gave the Kelvin lecture to the Institution of Electrical Engineers on November 7. He chose as his subject "The Dynamical Theory of Electric Engines," and began by quoting a formula for inductance or "electromagnetic capacity" which Kelvin gave in the 1860 edition of Nichol's "Cyclopædia" (see Thomson's "Reprint," p. 443). He suggested that this formula and the equally well known theorem for the mutual action between electric circuits when their currents are maintained constant had been overlooked by electricians, who merely considered what may be called the statical theory of the dynamo. Mr. Atkinson then developed an analogy between the cycle of an electromagnetic engine and the cycle of a reciprocating engine, deducing what appeared to us to be very curious formulæ for the efficiency of the various cycles. He excused his neglect of the resistance of the windings of the electric machines by pointing out that in the future some material of very small resistance may be discovered from which they can be made. Nothing was said either about hysteresis or armature reaction. In order that Kelvin's theorem might apply, Mr. Atkinson had to suppose that the currents in the coils were absolutely constant. Various triple integral formulæ well known to mathematicians were given for the energy stored up in the field, but we could not follow what use he made of them. It is difficult to see how the method developed can be of any practical use. It may be pointed out that the dynamical theory of the dynamo has been developed by Lyle, Russell, and several French electricians, who have based solutions on the conservation of energy and inductance formulæ on the lines laid down by Kelvin. Their results take cognisance of both resistance and armature reaction, and are in close agreement with experiment. As in all other theories, however, the assumption is made that the iron has constant permeability.

AMONG the books mentioned in the new announcement list of *Messrs. Longmans and Co.* we notice the following:—"Boiler Chemistry," J. H. Paul, with diagrams. "The Natural Organic Colouring Matters," Prof. A. G. Perkin and Dr. A. E. Everest; "Catalysis in Industrial Chemistry," Prof. G. G. Henderson; and "Plantation Rubber," G. S. Whitby (Monographs on Industrial Chemistry). "The Rare Earth Metals," Dr. J. F. Spencer, and a new edition of "Osmotic Pressure," Dr. A. Findlay (Monographs on Inorganic and Physical Chemistry). "Naval Architects' Data," J. Mitchell and E. L. Attwood; "Experimental Education," being a new and enlarged edition of "Introduction to Experimental Education," Dr. R. R. Rusk; and "Economic Reconstruction," J. Taylor Peddie.

THE following additions will shortly be made to the series of "Military Medical Manuals," edited by Sir A. Keogh (*Hodder and Stoughton*):—"Commotions and Emotions of War," Prof. A. Léri, edited by Sir John Collie; "Disabilities of the Locomotor Apparatus, the Result of War Wounds," Prof. A. Broca, translated by Capt. J. R. White and edited by Sir Robert Jones; "Electro-diagnosis of the War," Prof. A. Zimmern and P. Perol, translated by L. P. Garrod and edited by E. P. Cumberbatch; "Mental Disorders of the War," Prof. J. Lépine, edited by Dr. C. A. Mercier; "Wounds of the Pleura and Lungs," Prof. R. Grégoire and Dr. A. Courcoux, edited by Lt.-Col. C. H. Fagge.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET.—This comet is now quite an easy object in a moderate telescope. Mr. R. L. Waterfield observed it at Cheltenham with a 4-in. refractor early in November. It was brighter than 9th magnitude with central condensation, but no stellar nucleus, diameter about 2′. The brightness will continue to increase throughout November, and the increasing north declination will facilitate observation.

ORBITS OF TWO SPECTROSCOPIC BINARIES.—Further interesting investigations of spectroscopic binaries are recorded in Bulletins Nos. 314 and 315 of the Lick Observatory. In the case of p Velorum, magnitude 4·1, Class F2, the spectra of both components are exhibited, and Dr. R. F. Sanford finds that the mass ratio is 1·23. Adopting Russell's average mass for F stars of three times that of the sun, the inclination of the orbit would be 27°. With this inclination the semi-major axes of the two orbits would be 10,880,000 km. and 13,340,000 km. respectively. The period is 10·210955 days, and the eccentricity 0·541. From some of the best spectrograms Messrs. Adams and Joy find the absolute visual magnitude to be +1·9 and the parallax 0·036″.

The star σ Scorpii, magnitude 3·1, class B1, has been investigated by Dr. F. Henroteau, whose value of 0·246834 day confirms previous conclusions as to the extreme shortness of the period. The semi-amplitude of each velocity curve has the constant value of 41·2 km. per second, but the velocity of the centre of mass is variable, as if a third body were present.

The centre of mass describes an elliptic orbit in a period of 34·08 days, with a semi-amplitude of 33 km. per second. The spectral lines vary in width, and are broadest near periastron. Some of the peculiarities of the star may be due to its being actually involved in the nebulous matter by which it appears to be surrounded.

A REMARKABLE HELIUM STAR.—A notable exception to the rule that the helium stars are usually characterised by small parallax, small proper motion, and low radial velocity has been found by Mr. J. Voûte in the star Boss P.G.C. 1517 (*Astrophysical Journal*, vol. xlviii., p. 144). The investigation was undertaken at the suggestion of Prof. Kapteyn, who had suspected that this star might be found to have the unusually large parallax of about a tenth of a second. Mr. Voûte's result is $+0·069'' \pm 0·006''$, in good agreement with Prof. Kapteyn's supposition. For the proper motion Mr. Voûte has found $+0·235'' = 0·0185$s., but this is greatly in excess of the value $-0·0001$s. given in Boss's catalogue, and needs further confirmation. The radial velocity of the star is also exceptionally large, amounting to +83 km. per second. The position of the star for 1900 is R.A. 6h. 0m. 37s., decl. $-32° 10' 12''$, and the magnitude 5·6.

THE ORBIT OF SIRIUS.—The results of a new determination of the elements of the orbit of Sirius are given by Dr. R. Aitken in Lick Observatory Bulletin, No. 316. The elements with their probable errors are :—

$P = 50·04$ years $\pm 0·09$ year	$i = +43° 31' \pm 0·25°$
$T = 1894·133 \pm 0·011$ year	$\omega = 145·69 \pm 0·38$
$e = 0·5945 \pm 0·0023$	$\Omega = 42·71 \pm 0·33$
$a = 7·570''$	

Dr. Aitken concludes that the available micrometric and spectrographic data give no evidence of departure from undisturbed elliptic motion. It will be observed that the period given above is in close agreement with that of 50·02 years recently deduced by Jonckheere.

PRODUCTION IN THE SEA.[1]

A HIGHLY interesting report by Dr. C. G. J. Petersen describes the methods and results of recent work on the evaluation of the bottom fauna and flora of the sea in the Kattegat, Limfjord, and elsewhere. Abandoning the use of the dredge, as affording misleading ideas of the abundance of life on the bottom, the author invented his "bottom-samplers," which are apparatus that can lift up a sample of the sea-floor with its contained animals and plants. The area of bottom lifted varies between 0·1 and 1 square metre, the smaller apparatus being used at the greater depths. By a process of washing, the organisms are removed, counted, and weighed. The plates represent typical results, all the organisms found being drawn, in actual size, on paper ¼ square metre in area, which is then reduced to ⅝ in. linear.

Very often the bottom deposit consists of a "black, malodorous mass of sulphurous mud," and it was difficult to imagine that animals could utilise this as food. Sampling this by means of a glass tube thrust down into it, it was, however, seen that there was a thin surface layer of quite different composition, grey or brown in colour, and charged with vegetable remains. Oysters and other bivalves and demersal worms do not feed on the black mud or on the plankton in the water, but "literally stuff themselves with this upper layer of fine detritus." "The great bulk of the bottom animals are, and must necessarily be, herbivorous." They mostly burrow in the mud, but a large number are attached to solid objects, stones, and shells. These constitute the bottom epifauna.

The bottom fauna in general may be divided up into "communities," each characterised by one or more predominant forms; thus the author describes the bottom in the deeper parts of the Kattegat as inhabited by communities of *Amphilepis pecten*, *Brissopsis sarsii*, *B. chiajei*, and *Echinocordatum filiformis*, the typical forms present in each case being indicated by the systematic names.

The survey being a quantitative one, an attempt is made at an actual estimate of the mass of life in the whole Kattegat. There are about 24,000,000 tons of Zostera, 50,000 tons of plaice, 6000 tons of cod, 7000 tons of herrings, 25,000 tons of starfishes, 50,000 tons of predatory Crustacea and Gastropods, 10,000 tons of small fishes, with, of course, much else. These estimates are based, not only on the results of bottom-samples, but also on fishery statistics, the very probable assumption being made that the fish stock is practically constant, so that the fraction taken in commercial fishing represents the production.

No attempt is made to compare density of life on sea-bottom and land. "Strange as it may seem," says the author, "there does not exist any survey of the animal communities on land based upon quantitative investigations of the commoner species." J. J.

[1] Report of the Danish Biological Station to the Danish Board of Agriculture. "The Sea Bottom and its Production of Fish Food." By C. G. Joh. Petersen. Pp. 62+10 plates+chart. (Copenhagen, 1918.)

MILITARY EXPLOSIVES OF TO-DAY.[1]

THERE have been no epoch-making discoveries in explosives such as, say, the discovery of nitroglycerine for many years. Nitroglycerine, discovered in 1846, still remains the most powerful explosive in practical use. Many useful advances have been and are being made, but new explosives are merely new mixtures of old materials, given fancy names. The nations at war use practically the same explosives, and no one can be said to be ahead of the others.

The following table gives a comparison of some of the most typical explosives in use :—

Name of Explosive	Volume of gas per gram in c.c. = V	Calories per gram = Q	Coefficient = Q × V ÷ 1000	Coefficient G.P. = 1	Calculated temperature = $\frac{Q}{C}$. Assuming C = 0·24 C = Specific Heat of Gases
	c.c.				° C.
Gunpowder	280	738	207	1	2240
Nitroglycerine	741	1652	1224	6	6880
Nitrocellulose (13 per cent. Nitrogen)	923	931	859	4·3	3876
Cordite, Mk. I. (N.G.=57, N.C.=38, Vaseline=5)	871	1242	1082	5·2	5175
Cordite M.D. (N.G.=30, N.C.=65, Vaseline=5)	888	1031	915	4·4	4225
Ballistite (N.G.=50, N.C.=50, Stabiliser=0·5)	817	1349	1102	5·3	5621
Picric Acid (Lyddite)	877	810	710	3·4	3375

The coefficients correspond fairly well with the results obtained in practical use.

Detonating substances are called *high explosives*, and their immense shattering effect is due, not only to the volume of gas and quantity of heat, but also to the velocity of detonation and density of the explosive. Shattering power is proportional to

Volume of gas per gram × cals. per gram × velocity of detonation × density.

[1] From three Cantor Lectures delivered before the Royal Society of Arts in April last by J. Young, Chief Instructor in Science, Royal Military Academy, Woolwich.

Detonation is more easily started in powder or crystals, probably because there is a smaller mass to take the initial shock; but the wave travels slowly, and may die out in a loose powder. Advantage is taken of this fact in detonating shells. Detonation is first set up in crystals or pellets, and transmitted to the dense filling.

Mixtures of high explosives which require different waves are always difficult to detonate.

Amatol, a mixture of T.N.T. and ammonium nitrate, is more difficult to detonate than pure T.N.T.

Ammonium Nitrate Mixtures.

Ammonal.—One of the best known and most used of the ammonium nitrate mixtures is ammonal, in which use is made of the great heat given out by the oxidation of aluminium. A mixture of aluminium powder with the theoretical amount of ammonium nitrate for complete oxidation would contain 81·6 per cent. of NH_4NO_3. It would yield 1578 calories per gram—nearly as much as nitroglycerine—and 682 c.c. of gas. But such a mixture is difficult to detonate, and charcoal was added to make it more inflammable.

All cartridges must be hermetically sealed to preserve them from moisture, which quickly ruins ammonal. The velocity of detonation is about 4000 metres per second, and the effect intermediate between that of gunpowder and that of dynamite. Its power is three to four times that of gunpowder.

Sabulite.—This is an explosive resembling ammonal, but calcium silicide, Ca_2Si, an electric-furnace product, takes the place of the aluminium. Its composition is as below:—

	Per cent.
Ammonium nitrate	78
Trinitrotoluene	8
Calcium silicide	14

It is detonated in the same way as ammonal, and has about the same power.

Amatol.—This is a mixture of ammonium nitrate and T.N.T. in various proportions, which is now of great importance. T.N.T. does not contain enough oxygen for its complete combustion, and although the addition of ammonium nitrate increases the weight of the charge, the increase of the heat given out more than compensates for this.

The higher the proportion of ammonium nitrate, the greater the difficulty of detonation, and the difficulty increases when the ammonal is melted and cast into solid blocks or slabs, as is necessary for shells. Hence the higher proportions are used in the form of powder for bombs, grenades, and mines, and detonated by fulminate detonators. The others, used for shell-filling, are detonated by special methods, and will be referred to later.

All varieties of amatol are powerful high explosives. The velocity of detonation is about 4500 metres per second. All are spoiled by moisture and must be waterproofed, and all are practically smokeless.

Chlorate Mining Explosives.

All the older chlorate explosives are much too sensitive for use in large quantities in military operations. But a discovery made by Street in 1897, that if the chlorate mixture contained oils or fats its sensitiveness was greatly decreased, initiated an entirely new set of blasting explosives.

Blastine.—This is the most important military chlorate explosive, and vast quantities have been used in the present war. There are several varieties, but a typical military blastine has the following composition:—

	Per cent.
Ammonium perchlorate	60
Sodium nitrate	22
Trinitrotoluene	11
Paraffin wax	7

It is made in the form of a soft, yellowish, granular substance, which can easily be compressed.

Permite.—This is a mixture intermediate between ammonal and blastine, and may be looked on as ammonal in which the expensive aluminium is replaced by zinc powder, the consequent diminution in power being compensated for by using ammonium perchlorate instead of the nitrate. It is made in several varieties.

All the chlorate explosives require fulminate detonators, and for this reason, besides being too sensitive, are unsuitable for use as a high-explosive shell-filling. The rate of detonation is 4000 to 5000 metres per second.

Mixtures of ammonium perchlorate and paraffin wax with combustibles such as aluminium powder or wood-meal are also used, and are powerful high explosives.

Thermit, now an important munition of war, is in a class by itself. It is used for charging incendiary bombs, and sometimes in a kind of shrapnel. A small explosive charge scatters the contents, which rain down bits of blazing iron, which will instantly set fire to anything capable of burning.

Nitrocellulose, containing 12·5 per cent. of nitrogen and soluble in alcohol-ether, or at least completely gelatinised by it, is now made on an enormous scale, and constitutes 99·5 per cent. of nitrocellulose smokeless powders, as well as being used in the new cordite.

Guncotton was formerly used exclusively for torpedo warheads, marine mines, etc., but has now been largely replaced by T.N.T. and ammonium nitrate and chlorate mixtures.

There are two varieties of smokeless military powders in use at present: (1) *Nitrocellulose powders,* which consist of 99·5 per cent. of gelatinised nitrocellulose, and 0·5 per cent. of a preservative; and (2) *nitroglycerine powders,* which are gelatinised mixtures of nitroglycerine and nitrocellulose, with a few per cent. of a stabiliser.

American nitrocellulose powder (N.C.T.) is typical of the first class. It is made from soluble nitrocellulose containing about 12·5 per cent. of nitrogen.

N.C.T. is a good powder, and fairly stable. It is the weakest of the smokeless powders. Charges must be about 10 per cent. heavier than with cordite to give the same muzzle velocity.

N.C.T. is now much used in our Service for guns and howitzers, the charges being adjusted to give the same muzzle velocity as cordite M.D.

Cordite Mk. I. is a very powerful propellant, but owing to the high temperatures produced it is very erosive, and as a result of the South African War a modified cordite, "Cordite M.D.," was introduced. It has the composition: guncotton 65, nitroglycerine 30, mineral jelly 5. Its power is about 10 per cent. less than that of Mk. I., but the guns last three times as long. Cordite M.D. is the standard British propellant, although others are used at present.

In a new modified cordite soluble nitrocellulose is used instead of guncotton, and alcohol-ether is used for the gelatinisation instead of acetone. It contains a larger percentage of nitroglycerine than cordite M.D., but is very similar, although not quite so powerful.

High Explosives for Shell-filling.

A high explosive, in order to be suitable for shell-filling, must possess special qualities not necessary when it is used for other purposes, even in bombs and torpedoes.

None of the shell high explosives possess all the desirable qualities. Those now in use have little more than half the shattering power of blasting gelatine. All are products derived from the distillation of coal.

In spite of its great merits, picric acid has now been largely replaced as a shell-filling by trinitrotoluene and amatol.

Given that the picric acid is pure and proper precautions have been taken, it is quite safe and the most powerful shell-filling in use. It is also unaffected by high atmospheric temperatures, unlike T.N.T., and is specially suitable for tropical climates.

Trinitrotoluene ($C_6H_2(NO_2)_3CH_3$).—Usually called T.N.T., this substance, at present the most important of the shell high explosives, is known in the Service as trotyl. When heated to about 300° C., T.N.T. ignites and burns with a hot, but very smoky, flame. When a large mass is involved, the heat given out will invariably raise the temperature to the detonating-point. It is fully detonated by fulminate, except when in the form of cast slabs untamped, when the addition of a little lead azide to the fulminate is necessary. Fulminate detonators are used in bombs, torpedoes, and grenades. T.N.T. can also be detonated by less sensitive substances, such as picric powder and tetryl, and these are used in shells. The velocity of detonation in its densest form is about 7000 metres per second. The power is less than that of picric acid, about in the proportion of 91 : 100. Owing to the inferior velocity of detonation, the shattering effect (brisance) is proportionately still less, about 87 : 100.

When an amatol shell detonates there is only a little grey smoke, and no definite indication as to whether detonation has been complete or not. For observation purposes a packet of smoke producer is put in. The power is a little greater than that of pure T.N.T., but the velocity of detonation much less—4000 to 4500 metres per second, so that the local shattering effect is much less. For some purposes this is even an advantage.

Amatol is the most used of all the shell high explosives at present.

Tetranitromethylaniline ($C_6H_2(NO_2)_3NCH_3NO_2$).—This substance is known in the trade as tetryl, and in the Service as C.E. (composition exploding). It is readily detonated by a very small charge of fulminate, such as that used in shell detonator caps, is very powerful, and has a velocity of detonation of more than 7000 metres per second. It is an excellent initiator of detonation in other less sensitive explosives. In powder, pellets, and cylinders it is used in the gaines or detonators for T.N.T. and amatol shells, with which it is very effective.

Detonation of High-explosive Shells.—The problem of the detonation of a high-explosive shell is difficult. The shell is subjected to an enormous shock in the act of firing, the detonating charge must be in intimate contact with the filling, and if fulminate were used there would be a great risk of this being detonated by the shock. The problem seems to have been solved by the introduction of the gaine method.

The Gaine.—The gaine is a metal tube screwed to the fuse, which enters a cavity in the filling and makes good contact with it. This is very necessary. It contains a chain of substances, about four, of decreasing order of sensitiveness, starting from the fuse, and increasing order of violence of explosion. Use is made of the fact that a substance in powder is more easily detonated than when in compressed pellets, and pellets than a cast, dense solid. The actual substances vary with the shell and nature of the filling, but always start with gunpowder, which is very certain in action. Thus we may suppose the chain to consist of (1) gunpowder, (2) tetryl powder, (3) tetryl pellets, and (4) T.N.T. pellets.

The action is started by a fulminate cap in the fuse, which fires the gunpowder. This partially explodes and partially detonates No. 2, which detonates No. 3, which in turn detonates No. 4, and this detonates the main filling. With fuse and gaine in good condition there are very few failures now.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ABERDEEN.—Lord Cowdray has been elected Rector of the University in succession to Mr. Churchill, who has occupied the position for the last four years.

THE Mercers' Company has given 125*l.* towards the maintenance fund of the Cancer Investigation Department of the Middlesex Hospital.

THE sum of 1000*l.* has been given to the City of London School by Prof. Carlton Lambert for the foundation of a science scholarship.

A RESEARCH fellowship of the annual value of 150*l.* has been founded at Guy's Hospital in memory of the late Lieut. R. W. Poulton Palmer and his sister, the late Mrs. E. H. A. Walker, the object of which will be the investigation of obscure diseases in man.

THE London County Council has arranged a series of addresses to London teachers on various aspects of the problem of national reconstruction after the war. The first two addresses will be:—November 22, "The British Commonwealth," by C. Grant Robertson; and December 11, "Hours of Labour," by Lord Leverhulme. Sir Cyril Cobb, chairman of the Education Committee of the Council, will preside at these lectures. Other lectures in connection with reconstruction will be given on the following subjects:—Economic Recovery, Housing, Agriculture and Rural Life, Women's Employment, Adult Education, Food Supply, International Relations, India, and National Health. The lectures are arranged for London teachers, but other persons can be admitted if accommodation is available. Applications for tickets should be made to the Education Officer, L.C.C., Education Offices, Victoria Embankment, W.C.2, marked H. 45. A stamped addressed envelope should be enclosed.

ONE of the main matters to which Sir J. J. Thomson's committee on the position of natural science in the educational system of Great Britain gave attention was the provision of courses intended to stimulate interest in natural facts and phenomena and their human aspects. The appearances and movements of the heavenly bodies are particularly suitable for observations and instruction of this kind, yet few pupils leave school with any knowledge of them, and most people go through life without an intelligent understanding of the simplest facts of astronomy. Sir Frank Dyson, the Astronomer Royal, in an address to the British Astronomical Association on October 30, urged that the claims of astronomy should be borne in mind in any schemes for the broadening of science teaching in schools. A certain amount of valuable work in this direction is done already in connection with the practical geography lessons; and the British Association Report on Science Teaching in Secondary Schools contains, in one of the syllabuses, much useful guidance to such observations. Sir Frank Dyson rightly lays stress upon the educational value of work with terrestrial and celestial globes, the latter in a simplified form and showing the position of the sun in the ecliptic on, say, the first day of each month. He suggests also that an orrery should be used to make clear the transference from the geocentric to the heliocentric point of view, and that a 4-in. telescope should be provided wherever possible to observe sun-spots, the lunar surface, Jupiter's satellites, and the phases of Venus. Such observations, together with simple lessons on the applications of spectroscopy to elucidate the composition of the sun, stars, nebulæ, etc., illustrated by some of the excellent astronomical photographs now available, should do much to remove the reproach that nothing is done in schools to encourage pupils to lift their eyes to the heavens and learn something of the universe around them.

THE endowment fund now being raised for the establishment of a University College in Swansea has been augmented by donations of 25,000*l.* from Mr. F. Cory Yeo and 10,000*l.* from Mr. W. T. Farr, retiring directors of the Graigola Merthyr Co., Ltd., 5000*l.* of the former donation to be devoted to scholarships "in the first place for Graigola boys, and, if any after, for open competition." The University College scheme originated in a movement to secure for the Swansea Technical College recognition in the faculties of science and technology as a constituent college of the University of Wales. The governors and staff were of opinion that for a full development of the higher work of the college University recognition and association were essential. To this end the governors approached the recent Royal Commission on University Education in Wales, asking for a direct recommendation that the college should find a place in at least the above-mentioned faculties in the reorganised University. A proof that the application was backed by the community was the establishment in the course of a few weeks before the end of 1916 of an endowment fund exceeding 65,000*l.*, in addition to which the Swansea Town Council undertook to provide all necessary land and buildings. The Royal Commission reported very favourably, but laid down that the new University College must make provision for work in the faculty of arts. To assist in fulfilling this condition, the Swansea Council has agreed, subject to the consent of the Board of Education, to bring in its Training College for Teachers as part of the scheme. This will enable full provision to be made in the faculty of arts, science, and technology, but necessitated an appeal for a much larger endowment fund, a minimum of 150,000*l.* being the present aim. Messrs. Cory Yeo's and W. T. Farr's donations are the first-fruits of this appeal, and brings the gifts or promises well above 100,000*l.* The college has also received notice of a bequest of the residue of the estate of the late Mr. T. P. Sims, assayer, of Swansea, the bequest being subject to a life-interest. The value of the residue is estimated at more than 10,000*l.*, and the income is to be devoted to scholarships in chemistry, metallurgy, and modern languages.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 7.—Sir J. J. Thomson, president, in the chair.—Prof. G. E. **Hale**: The nature of sun-spots.—E. O. **Hercus** and T. H. **Laby**: The thermal conductivity of air.—T. K. **Chinmayanandam**: Haidinger's rings in mica.

Aristotelian Society, November 4.—Dr. G. E. Moore, president, in the chair.—Dr. G. E. **Moore**: Some judgments of perception. The question of the real nature of material things is approached by asking what we are judging when we make such judgments as, "This is a coin." Two things seem to be certain, viz. (1) that we are always making some assertion about an immediately given object—an object which has sometimes been described as "the sensation which mediates our perception of the coin in question," and which will be called the sense-datum which is the subject of our judgment—and (2) that what we are asserting about the sense-datum is not, in general, that it is itself a coin. What is doubtful is whether we may not be judging that the sense-datum is itself a part of the surface of a coin, in a sense in which this can only be so if it is identical with "this part of the surface of this coin." This is only possible if, when we seem to perceive that a sense-datum is of a certain size, shape, etc., we really only perceive that it seems to be so, in a sense in which it may seem to be so without being either judged or perceived to be so. Failing this, either (1) there must be some relation such that we are judging "The thing to which this sense-datum has this relation is part of the surface of a coin," and it seems doubtful whether there is any such relation, or (2) we must take some view of the type of Mill's.

CAMBRIDGE.

Philosophical Society, October 28.—Prof. Marr, president, in the chair.—Prof. L. J. **Rogers** and S. **Ramanujan**: Proof of certain identities in combinatory analysis.—S. **Ramanujan**: Some properties of p (n), the number of partitions of n.—Miss D. M. **Wrinch**: The exponentiation of well-ordered series.—A. E. **Jolliffe**: Certain trigonometrical series which have a necessary and sufficient condition for uniform convergence.—H. W. **Turnbull**: Some geometrical interpretations of the concomitants of two quadrics.—H. B. C. **Darling**: Mr. Ramanujan's congruence properties of p (n).—B. **Sahni**: The correct generic position of *Dacrydium bidwillii*, Hook. f. This species, and by inference probably also *D. kirkii* and *D. biforme*, hitherto regarded as forming an interesting transition to the genus Podocarpus, are really species of the latter genus. At least in *D. bidwillii* the epimatium is not entirely free from the integument, nor the integument from the nucellus. The integument, moreover, contains two vascular strands exactly in the same position as in *Podocarpus ferrugineus*, but not quite reaching the level of the equator. In view of the dry epimatium and other features, it is proposed provisionally to place all these New Zealand species of Dacrydium in a new and distinct section of the genus Podocarpus, allied to section Stachycarpus.

PARIS.

Academy of Sciences, October 21.—M. Léon Guignard in the chair.—E. **Picard** and A. **Lacroix**: The Inter-Allied Conference of Scientific Academies in London.—H. **Sebert**: Notice on M. Marcel Deprez.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: Temporary and definite survival after serious bleeding. In previous papers it has been proved that in the case of dogs, after grave loss of blood, injection into the veins of suitable fluids would prolong life, but after three or four hours the improvement in the condition of the animal disappears and death ensues. The survival is only temporary. Summarising the results communicated in this and previous papers, the authors conclude that the only efficacious treatment after heavy loss of blood appears to be transfusion.—P. **Appell**: Addition to the note on an ordinary differential equation connected with certain systems of linear and homogeneous partial differential equations.—H. **Douvillé**: The geology of the neighbourhood of Argeles and the Pic de Gez.—P. **Termier** and W.

Kilian: The composition of the Miocene conglomerates of the French sub-alpine chains.—L. **Jouane**: The elasticity of pure cement. Measurements were made of the flexion of small test pieces of cement when submitted to small forces, no permanent deformation resulting. The strains were proved to be proportional to the stresses applied, and the modulus calculated from various test pieces was constant within 1 per cent.—H. **Guilleminot**, H. **Cheron**, and R. **Biquord**: An X-fluorometer with radio-luminescent standard.—P. **Georgevitch**: Study of the sexual generation of a brown alga.—H. **Agulhon** and R. **Legroux**: Contribution to the study of the vitamines utilisable in the culture of micro-organisms. Application to the influenza bacillus (*B. pfeiffer*).—Sir Almroth E. **Wright**: The production of non-specific bactericidal substances by means of anti-staphylococcic and anti-streptococcic vaccines *in vivo* and *in vitro*.—R. D. de la **Rivière**: Is the poison of influenza capable of passing through a filter? Blood from influenza patients was defibrinated and filtered through a Chamberland filter (L_3). A portion of the filtrate injected under the skin produced influenza symptoms in the author, which are described in detail. A second injection ten days after the first gave rise to no morbid symptom.—C. **Nicolle** and C. **Lebailly**: Some experimental ideas on the virus of influenza. The bronchial expectoration in cases of influenza collected during the acute period is virulent. The ape is sensible to the infection.—J. **Nageotte** and L. **Sencert**: The utilisation of dead grafts for the surgical repair of tissues of a conjunctive nature.

BOOKS RECEIVED.

The Illinois and Michigan Canal: A Study in Economic History. By Prof. J. W. Putnam. Pp. xiii+213. (Chicago: University of Chicago Press.) 2 dollars.

The Student's Handbook to the University and Colleges of Cambridge. Seventeenth edition, revised to June 30, 1918. Pp. vi+717. (Cambridge: At the University Press.) 6*s*. net.

The Iron and Steel Institute. Carnegie Scholarship Memoirs. Vol. ix. Pp. iv+169. (London: E. and F. N. Spon, Ltd.)

State of Connecticut. Public Document No. 24:—Forty-first Annual Report of the Connecticut Agricultural Experiment Station. Pp. xvi+510. (New Haven, Conn.)

University of London. University College. Abridged Calendar. Session 1918–19. Pp. cxxx+250. (London: Taylor and Francis.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 14.

ROYAL SOCIETY, at 4.30.—A. Mallock: Sounds produced by Drops falling on Water.—G. H. Hardy and S. Ramanujan: The Coefficients in the Expansions of certain Modular Functions.—Hon. R. J. Strutt: The Light Scattered by Gases; Its Polarisation and Intensity.—Dr. F. Horton and Ann C. Davies.—An Investigation of the Ionising Power of the Positive Ions from a glowing Tantalum Filament in Helium.

OPTICAL SOCIETY, at 8.—T. Smith: Some Generalised Forms of an Optical Equation.—H. S. Ryland: The Manufacture of Binoculars.

MATHEMATICAL SOCIETY, at 5.—Annual General Meeting.—Prof. H. M. Macdonald (Retiring President): Presidential Address.—Prof. M. J. M. Hill: The Use of a Property of Jacobians to Determine the Character of any Solution of an Ordinary Differential Equation of the First Order, or of a Linear Partial Differential Equation of the First Order.—Prof. H. J. Priestley: The Roots of a Certain Equation in Spherical Harmonics.—J. Hodgkinson: A Detail in Conformal Representation.—T. A. Broderick: The Product of Semi-convergent Series.—Dr. W. P. Milne: A Simple Condition for Co-apolar Triangles.

FRIDAY, NOVEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—*Adjourned Discussion*: Prof. C. A. Edwards and F. W. Willis: A Law Concerning the Resistance to Penetration of Metals which are Capable of Plastic Deformation, and a New Hardness Scale in Fundamental Units.—R. G. C. Batson: The Value of the Indentation Method in the Determination of Hardness; and Dr. W. C. Unwin: The Ludwik Hardness Test.—T. T. Heaton: Electric Welding.

MONDAY, NOVEMBER 18.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Exhibition of Captured War Maps.

TUESDAY, NOVEMBER 19.

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—R. D. Oldham: The Constitution of the Earth's Interior.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—W. R. Ormandy: The Motor Fuel Problem.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—R. B. Joyner: The Tata Hydro-electric Power-supply Works, Bombay.

ZOOLOGICAL SOCIETY, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie in the Month of October, 1918.—Miss K. Lander: Exhibition of Skeletons, prepared by the "Trypsin" Method.—E. Hatschek: Notes on Investigations into the Forms of Drops and Vortices of Gelatin in Various Coagulants.—Dr. D. M. S. Watson: Seymouria, the most primitive known Reptile.

WEDNESDAY, NOVEMBER 20.

GEOLOGICAL SOCIETY, at 5.30.—R. Hansford Worth: The Geology of the Meldon Valleys, near Okehampton, on the Northern Verge of Dartmoor.

ROYAL SOCIETY OF ARTS, at 4.30.—A. A. Campbell Swinton: Science and the Future.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 5.—R. DeC. Ward: The Larger Relations of Climate and Crops in the United States.—Capt. C. J. P. Cave and J. S. Dines: Soundings with Pilot Balloons in the Isles of Scilly, November and December, 1911.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: W. Stiles and Dr. F. Kidd: (1) The Influence of External Concentration on the Position of the Equilibrium attained in the Intake of Salts by Plant Cells; (2) The Comparative Rate of Absorption of various Salts by Plant Tissue.—G. Marinesco: Récherches Anatomo-Cliniques sur les Névromes d'Amputations douloureux: Nouvelles Contributions à l'Etude de la Régénération nerveuse et du Neurotropisme.

LINNEAN SOCIETY, at 5.—E. S. Goodrich: A Fatherless Frog, with remarks on Artificial Parthenogenesis.—Miss Muriel Bristol: A Review of the Genus Chlorochytrium, Cohn.—A. S. Kennard and B. B. Woodward: The Linnean Species of Non-marine Mollusca that are represented in the British Fauna, with Notes on the Specimens of these and other British Forms in the Linnean Collection.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Everard im Thurn: The Present State of the Pacific Islands.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—R. R. Kahan: Refining Gold Bullion with Chlorine Gas and Air.—A. Yates: Effect of Heating and Heating and Quenching Cornish Tin Ores before Crushing.—R. J. Harvey: The Development of Galena Flotation at the Central Mine, Broken Hill.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. H. Shaw: The Use of High Pressure and High Temperature Steam in Large Power Stations.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

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

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THURSDAY, NOVEMBER 21, 1918.

PRINCIPLES OF RECONSTRUCTION.

NOW that the armistice has been signed and the prospect of peace in the near future is happily assured, it is inevitable that the whole nation should be impatient to get back to its normal activities. Four years of interruption in the ordinary life of a community is a serious break in the regular and ordered continuity of its existence, but whether it is an unmixed evil will depend upon the lessons and experiences to which it has given rise, and upon the extent to which those lessons and experiences are heeded. There has necessarily been a great dislocation of industry, and the forces of production have to a very large extent been made subservient to the demands of war. The immediate problem before us now is how to divert, with the least amount of friction and in the shortest possible time, the enormous amount of energy which has been devoted to the prosecution of war into the manifold channels of civil life and peaceful occupation.

"Business as usual" was a silly and futile cry at the beginning of the war, uttered by thoughtless people with no conception of the grim reality of the struggle into which we had been forced. In a certain sense the cry would be scarcely less futile now, since it is absolutely certain that business in the future will be very different, in many respects, from what it has been in the past. The centre of gravity of the whole system of international trade has been changed. Many years must elapse before the nations of Central Europe will be able to exercise any very great influence upon the world's commerce, and the present chaotic condition of Russia affords no hope that she can resume her pre-war position as a trading nation for some time to come.

The prestige and commercial credit of the larger part of Europe have, in fact, been so profoundly shaken that it is well-nigh impossible to forecast the trend of the world's trade in the immediate future. The plight of Germany and Austria is, of course, further aggravated by the political upheaval which has followed hard upon their military collapse. In such times of social and political stress it is not to be expected that their workers will settle down to the peaceful pursuits of production. The relations of capital and labour, already strained before the war, under the democratic rule which is now supreme in the shattered Empires will probably end in open rupture. The victorious nations, on the other hand, have an opportunity which, if they are wise, they will not be slow to seize. We did not desire this war, and we certainly did not enter upon it with any idea of commercial supremacy, but it would be the veriest folly not to attempt to realise the advantages of the good fortune which our triumph has placed within our reach. Prudence, indeed, should compel us to take occasion by the hand, and grasp the skirts of happy chance. We have spent our treasure without stint in the effort to crush one of the greatest conspiracies against humanity of which history has any record. We have saddled ourselves with a stupendous debt as a consequence, which no indemnity that we are likely to get or any increase of Colonial territory that may fall to our share as an Empire will adequately liquidate. Our only method of meeting the pecuniary obligation we have incurred is by augmenting our wealth by means of trade and commerce, and this can best be done by increasing our production, both in variety and amount.

The future, in fact, rests with labour, and it is upon the sanity and prudence of the workers and their employers that everything depends. The war has been attended with much social unrest, even in those nations which have come out victorious. The workers everywhere demand better conditions of life, a wider intellectual outlook, and a higher standard of comfort, and the nations which have fought the great fight in the interests of humanity sympathise with them in their demands. But as the world is constituted these can be secured only by a better organisation of our economic forces, by increased efficiency in management, greater skill, knowledge, industry, and marketing ability—matters in which the employers are concerned no less than the workers. It will be unspeakably sad if the nation should now throw away its golden opportunity in an internecine strife between capital and labour.

There are anarchical forces at work among us which are bent upon provoking this conflict, and it will require no little ability and courage on the part of labour leaders to counteract the mischievous efforts of those who would take a demoniacal delight in wrecking the industrial welfare of this nation. We believe the great mass of the workers in this country have too much sense to let themselves be infected by the spirit of Bolshevism, which leads to nothing but social chaos. But just as a little leaven leaveneth the whole lump, that pernicious spirit may be very troublesome before it is finally exorcised. What, therefore, is wanted is a reasonable spirit of conciliation on the part of employers and employed, and a determination, honest and sincere, on both sides to find an equitable solution. The spirit should be that of the King's message to his people, delivered on Tuesday in reply to addresses from both Houses of

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Parliament. "We have," the King said, "to create a better Britain, to bestow more care on the health and well-being of the people, and to ameliorate further the conditions of labour. May not the losses of war be repaired by a better organisation of industry and by avoiding the waste which industrial disputes involve? Cannot a spirit of reciprocal trust and co-ordination of effort be diffused among all classes? May we not, by raising the standard of education, turn to fuller account the natural aptitudes of our people and open wider the sources of intellectual enjoyment?"

The labour aspect of the matter was touched upon by the Minister of Reconstruction in the peroration of the statesmanlike pronouncement in which he explained to the House of Commons and the country the plans of the Government for the demobilisation of the Army, the re-settlement of officers and men in civil life, and the re-establishment of industry on a normal basis. Lengthy as the statement was, Dr. Addison could only deal with broad general principles, leaving the details to be worked out by the various administrative bodies which are charged with the duty of demobilisation and re-settlement. Considering the suddenness of the chief enemy's collapse, the Minister is to be congratulated on the comprehensiveness of his survey, and on the thoroughness with which the main features of the problem have been thought out in the comparatively short time that his department has been in existence. It says much for our business ability as a people, and for our powers of organisation in a national crisis, that a scheme so elaborate and so far-reaching should have been launched so promptly when the need for it had arrived.

We are, however, only on the very fringe of this great problem. There is still much to do before it is finally solved. However expeditiously the work of demobilisation and re-settlement may be done, the business will necessarily occupy considerable time. It will doubtless tax the energies and the patience of all concerned, and we must be prepared for the "grousing" which is a national characteristic, and not infrequently at times when there is really the least occasion for it. It may be pardoned, however, as one sign of reaction from the intense strain which the nation has suffered during the long and weary years which are past. When a patient begins to grumble, the tactful nurse is assured that the crisis is well past, and that renewed vigour has set in. And this observation reminds us that in the scheme of re-settlement Dr. Addison made no reference to the special case of the medical men. During the four years of war the country has suffered no small amount of inconvenience owing to the calling up of large numbers of medical practitioners for service in the Army. This was inevitable, and as it was necessary the deprivation was borne with patience and resignation. To what extent the national health has suffered it is impossible to say, but there is good reason to believe that the great mortality from the recent epidemic of "influenza" might have been largely obviated had medical advice and skill been more readily available. It is notorious that in some districts medical men were utterly unable to cope with the outbreak, owing to the fewness of their numbers. Its virulence would appear to be declining, but it is only scotched, not killed, and with much of the winter still before us, with food and fuel still short, and with the consequent lowering of the general vitality, it is a paramount necessity that the medical men should be released and re-settled as promptly as possible.

AN AMERICAN CHEMICAL DIRECTORY.

Annual Chemical Directory of the United States. Second edition, 1918. Pp. 534. (Baltimore, Md.: Williams and Wilkins Co., 1918.)

THE present issue of this work, of which the first edition appeared in 1917, differs only in certain minor details from the plan and arrangement of its predecessor. Its contents are grouped under nine main divisions or chapters. Chap. i. contains a list, in alphabetical order, of all chemical substances, made or imported, necessary for laboratory, technical, and industrial purposes, with the names of manufacturers and dealers placed geographically, first by States, and then by cities, and grouped alphabetically. The retailers, dealers, and agents are distinguished, so far as possible, from the manufacturers by an asterisk.

Chap. ii. consists of an alphabetical arrangement of the names of manufacturers and dealers under the alphabetical order of the States and their cities. Chap. iii. gives a list of chemical and chemical engineering apparatus, mechanical equipment, and machinery used in chemical works, arranged alphabetically and in general accordance with the method adopted in chap. i. as regards chemical products.

Chap. iv. consists of an alphabetical list of manufacturers and dealers in such apparatus and machinery, arranged on lines similar to those of chap. ii. Chap. v. gives the names (1) of American analytical and consulting chemists, and (2) of chemical engineers, listed geographically and grouped alphabetically as in the preceding chapters. Chap. vi. is a list of (1) industrial laboratories, (2) institutional laboratories, (3) Federal and State laboratories, (4) municipal laboratories, and (5) commercial laboratories. Chap. vii. gives the official names, arranged alphabetically, of technical and scientific societies concerned with the study of pure and applied chemistry, both in the United States and abroad. Chap. viii. deals with publications relating to chemistry, pure and applied, emanating from the various societies and publishing agencies, and contains a list of the more important books which have appeared in 1917–18. Chap. ix. consists of notes and news of important developments which have occurred since the first edition was published.

On the value of a work of this kind to all engaged in the practical pursuit of chemistry, whether as teacher or technologist, or even as dealer or agent, we have already dwelt in a notice of the first edition, and we expressed a regret that nothing exactly similar to it was to be found in our own country. Under the changed conditions due to the war, and owing to the quickened appreciation of the value of science, both pure and applied, to the national welfare, and to the greater recognition of the importance of co-operation and co-ordination of national effort, it can scarcely be doubted that such a work would be of the greatest service to those concerned in the chemical arts in this country, and would become practically indispensable. That such is the case in America with the present work seems to be obvious from the character of the new edition, in which apparently no pains have been spared in order to render it complete and comprehensive, and as convenient in use as possible.

From the last chapter, on "News and Notes," we extract a few items which are of interest at the present time as serving to show with what energy America is dealing with the conditions arising out of the war. She has largely developed the synthetic ammonia industry. Processes are being worked by the War Department and the Department of Agriculture, and the Air Nitrates Corporation has been officially appointed by the first-named Department to manufacture ammonium nitrate. The New York City Department of Health Laboratories are producing large quantities of antitoxins, and arsphenamine is being manufactured by the Dermatological Research Laboratories in Philadelphia, the Takamine Laboratory in New York, and what was formerly the Farbwerke Höchst Co. of New York City. The supply of hypnotics and anæsthetics of all kinds is no longer under German control.

In 1917 there were seventy concerns in the United States with benzol-recovery plant. The estimated production of benzol in 1917 was 35,000,000 gallons. The Midland Chemical Co., Michigan, is producing large quantities of bromine. Through the efforts of the United States Bureau of Mines and the American Chemical Society a complete detailed census has been taken of more than 15,000 American chemists. A number of American manufacturers of dyes are employing from twenty-five to seventy-five chemists in their research departments. The American dye industry has now invaded the market in European and Allied countries, South America, Canada, Japan, and India. It is estimated that in the early part of 1918 there were more than 150 firms actually producing "anilines" in the United States. The drug and chemical markets quote weekly nearly one hundred "crudes" and "intermediates," and more than two hundred dyestuffs are available in the United States market. The capital invested in the American dyestuff industry is estimated at 250,000,000 dollars, which is much above the amount of the total capital of the seven leading German companies in 1914. Up to the present, American chemists and manufacturers have placed on the market 75 per cent. of the dyestuffs formerly imported, and it is claimed that by the end of 1918 all necessary colours will be manufactured in the country.

When the war broke out in August, 1914, there were only six factories, employing possibly 350 to 400 operatives, manufacturing coal-tar colours, with an approximate production of 3000 tons. American dyestuffs in 1914 depended almost entirely upon the mere assembling of "intermediates" delivered from German sources. The total annual consumption of synthetic colours in 1914 in the United States was about 27,000 tons. To-day there are probably fifty responsible manufacturing establishments producing dyestuffs in America, and the production is well above 35,000 tons, all made from American coal-tar. In the classes of dyes which, if imported, would be dutiable at 30 per cent. *plus* 5 cents a pound, American manufacturers have shown remarkable progress. The production is so far in excess of the home needs that during the fiscal year 1917 American-made dyes were exported to the value of 11,709,287 dollars. Thus the exports exceeded the pre-war imports in total value, although not in tonnage or in the variety of the dyes. With a view to the protection of their interests in the economic war which is bound to follow, the American manufacturers have established a Dyestuff Manufacturers' Association. Other German industries, such as scientific and laboratory glassware and chemical and electrical porcelain, have been assailed in like manner, and America is now independent of imported supplies.

In 1915 the National Exposition of Chemical Industries was organised in order to foster the growth of chemical industries in America. It has now become an institution in the chemical industrial affairs of the country. The expansion of the Exposition is indicative in a measure of the growth of the chemical industries. In 1915 the number of exhibits was eighty-three; in 1916, 188; and in 1917, 323. In 1915 the visiting attendance was 63,000; in 1916, 80,000; and in 1917, 111,514.

Evidence of the astonishing influence of the war in quickening American energy and enterprise is seen in almost every department of chemical activity. At the end of 1917 practically every "intermediate" of importance was being produced in the country; the production of phenol in 1917 was more than double that of 1916. More than 200 plants are making sulphuric acid in the States, and the production of the present year will be 1,500,000 tons greater than in any previous year.

Germany has already had a rude awakening, but she has yet to realise the full measure of the economic ruin which awaits her.

ELECTRICITY AND HEALTH.

Studies in Electro-pathology. By Temp. Major A. White Robertson. Illustrated. Pp. viii+304. (London: George Routledge and Sons, Ltd., 1918.) Price 12*s.* 6*d.* net.

THIS book begins with the thesis that civilisation is a mistake because it is a negation of the "wild," the law of which is "Thou shalt be fit or thou shalt die." But we are justified in asking, What is "fitness"? The author appears to have left the development of the brain altogether out of consideration. Do music and painting count for nothing? The statement is made that "suffering has come with the law of the artificial"—that is, the civilised. If we are to accept this we must hold that all existences prior to civilisation were devoid of consciousness. Disease is certainly not absent from wild animals or men, and when the author says that it has increased enormously owing to civilisation, we must remember that the conditions producing it can and must be done away with, and this without abolishing civilisation itself. Moreover, is not the increase spoken of apparent merely and due to improved means of detection? It may be doubted whether the physician is the best judge as to the extent of the increase.

The conclusion of the book is that we must go back to the "law of the wild." How? By living in accordance with the theories of the essentially electrical nature of all physiological and pathological phenomena familiar to some of us in connection with the name of Mr. A. E. Baines. The effects of light are now added on account of their electrical nature. It is true that in the far distant future all phenomena may possibly be explained on the basis of the electrical structure of the atom; but no man living can do this, and the author's attempt can only be described as premature, a fact for which he cannot be held responsible. The book shows an extensive acquaintance with literature, although the quotations are apt to be rather disconnected and their relation to the argument not always obvious. The inner meaning attached to many of these quotations appears to be due to the electrical obsession of the author, who is not always consistent. On p. 57 he inclines to the view that enzymes are "forces"; on p. 115 he speaks of phosphorus as their essential factor, apparently, however, forgetting that a very active pepsin has been prepared free from phosphorus.

The reader must be warned against accepting without question the statements contained in the book. Mr. Baines's remarkable experimental results are quoted without criticism. No attempt is made to answer the objections that have been brought against them, and it is not to be expected that they will be believed until they have been described in such a way that others can repeat them. This applies especially to such experiments as that referred to on p. 231, where a boiled potato is made to sprout by the application of an electrical current. The electrical obsession is indicated also by the view taken that the function of the waxy or fatty layer on the surface of plants or animals is to prevent escape to the air of electrical charges.

The author holds the view that the constitution of "vitamines" is that of phospho-lipines, and his remarks about "quick" food must be referred to on account of the possible mischief that they may do. "Quick" food is that which has a particular electrical reaction, when tested by the method of Mr. Baines, on account of the presence of insulating lipoids. It is the only kind of food that is to be taken. Cold storage destroys this property, as also does over-cooking. But the remarks made as to the misleading nature of calorie values raise doubt as to the competence of the author to advise on problems of nutrition. The application of the theories to medical and surgical practice consists in the addition of a phospho-lipine, lecithin, or similar substance to Mr. Baines's "dielectric oil" or liquid paraffin.

W. M. B.

THE RADCLIFFE FOUNDATIONS.

Dr. John Radcliffe: A Sketch of his Life, with an Account of his Fellows and Foundations. By Dr. J. B. Nias. Pp. 147. (Oxford: At the Clarendon Press, 1918.) Price 12*s.* 6*d.* net.

DR. JOHN RADCLIFFE, a very successful Court physician at the time of William III. and Queen Anne, was one of the most generous of all the numerous benefactors of Oxford, for he left most of his large fortune to the University. He covenanted that a portion of it should be used to endow two travelling fellowships, to be held by Oxford medical graduates for the space of ten years, and he made a special proviso that at least half of this period should be spent by his fellows "in parts beyond the sea, for their better improvement." Radcliffe's idea was an excellent one, for few medical men could fail to broaden their outlook and increase their experience by visiting the most noted medical schools in foreign countries. At the same time the period of ten years is too long for most men, and so from 1859 onwards the tenure of the fellowships was reduced to three years. The list of fellows includes many distinguished names, and of those elected under the new foundation nearly twenty at the present moment hold appointments on the staff of one or other of the London hospitals. The book under review gives only brief records of living fellows, but detailed biographies of the deceased fellows of the old foundation.

The other foundations under Dr. Radcliffe's will include the imposing Radcliffe Library, or "Camera." For the first century or more after it was built this library was stored with books of all kinds, but from 1811 onwards they were restricted to scientific and medical subjects. In 1861 these science books were transferred to the recently built "Museum," whilst the library itself is now used as an annexe to the Bodleian Library.

Another notable foundation bearing Radcliffe's name is the observatory. This institution was not contemplated in Radcliffe's will, but it was founded in 1772 by the trustees out of the trust funds, at the request of leading members of the University. At the time of its erection the observatory was one of the largest and best-equipped in the world, and its equipment has been well maintained by the recent addition of a splendid telescope of 24-in. aperture for photographic work, and one of 18-in. aperture for visual work, on the same mounting. Just previous to the foundation of the observatory the trustees sanctioned the building of the Radcliffe Infirmary, which has ever since remained the chief county hospital.

In addition to a description of the Radcliffe foundations, Dr. Nias (himself an ex-travelling fellow) gives a brief but interesting biography of Radcliffe. The book contains numerous portraits and illustrations, and is beautifully printed and produced, but it is to be feared that its circulation will be limited by its somewhat excessive price.

H. M. V.

OUR BOOKSHELF.

Elements of the Electromagnetic Theory of Light. By Dr. Ludwik Silberstein. Pp. vii+48. (London: Longmans, Green, and Co., 1918.) Price 3*s*. 6*d*. net.

THIS little volume is re-written from the author's Polish treatise on electricity and magnetism (3 vols., Warsaw, 1908–13). It is a compact *résumé* of the main results of the electromagnetic theory of light in so far as it can be carried without reference to the electron theory. The main purpose seems to be to present the subject to the English reader in vectorial notation, following the symbolism of the author's "Vectorial Mechanics" (Macmillan, 1913). It would have added to the usefulness of a book designed for beginners in the subject if a short exposition of the meaning of the notation had been prefixed, an addition which would have helped to familiarise the rising generation with a very important calculus.

A useful historical survey of earlier æther-theories is given in the second chapter.

The Exploitation of Plants. By Various Writers. Edited by Prof. Oliver. (The Imperial Studies Series.) Pp. vii+170. (London: J. M. Dent and Sons, Ltd., 1917.) Price 2*s*. 6*d*. net.

PROF. OLIVER has done a useful piece of work in bringing together, within the compass of a small volume, a series of lectures on "The Exploitation of Plants in the Service of Man," which was delivered at University College, London, in 1917. In such a collection it is inevitable that there should be differences in relative values, but the standard of the best is very high. Amongst those which strike us as particularly good are the contributions of Prof. Oliver himself, and that of Dr. Willis, formerly director of the celebrated gardens at Peradeniya. As might perhaps have been anticipated, these are concerned with the reclamation of waste lands and with the rubber industry respectively. Both are characterised by first-hand knowledge and that indefinable but very real quality that attaches to pioneer work. Dr. Balls contributes a suggestive article on cotton and its problems, but here and there he is inclined, perhaps, to assume a more extensive technical acquaintance with the subject on the part of the reader than the latter could actually justify.

One essay is markedly egotistical, and the instructed reader will find some entertaining "information" in the lecture dealing with the plant as healer. Amongst other curious statements, the account therein given of the cinchona enterprise in Ceylon manages in a few lines to convey a thoroughly misleading impression of the causes which led to the collapse of that particular industry in the island.

But a book of this kind should, after all, be judged on its merits as a whole, and while it must be admitted to contain some dross, the greater part of it is good, and the best is really first-rate.

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 Perception of Sound.

I DO not think that Helmholtz's theory of audition, whatever difficulties there may be in it, breaks down so completely as Dr. Perrett represents (NATURE, November 7). According to him, one consequence of the theory would be that "when a tuning-fork is made to vibrate, no note can be heard, but only an unimaginable din." I cannot admit this inference. It is true that Helmholtz's theory contemplates the response in greater or less degree of a rather large number of "resonators" with their associated nerves, the natural pitch of the resonators ranging over a certain interval. But there would be no *dissonance*, for in Helmholtz's view dissonance depends upon intermittent excitation of nerves, and this would not occur. So long as the vibration is maintained, every nerve would be uniformly excited. Neither is there any difficulty in attributing a simple perception to a rather complicated nervous excitation. Something of this kind is involved in the simple perception of *yellow*, resulting from a combination of excitations which would severally cause perceptions of red and green.

The fundamental question would appear to be the truth or otherwise of the theory associated with the name of J. Müller. Whatever may be the difficulty of deciding it, the issue itself is simple enough. Can more than one kind of message be conveyed by a single nerve? Does the nature of the message depend upon how the nerve is excited? In the case of sound—say from a fork of frequency 256—is there anything periodic of this frequency going on in the nerve, or nerves, which carry the message? It is rather difficult to believe it, especially when we remember that frequencies up to 10,000 per second have to be reckoned with. Even if we could accept this, what are we to think when we come to nerves conveying the sensation of light? Can we believe that there are processes in action along the nerve repeated 10^{15} times per second?

I do not touch upon the anatomical matters treated by Sir T. Wrightson and Prof. Keith, or upon the phonetic evidence brought forward with authority by Dr. Perrett. RAYLEIGH.

Zeiss Abbe Refractometer.

IN an interesting note by Mr. Churcher communicated to the Physical Society of London (Proc. Roy. Soc., vol. xxx., part iii., April 15, 1918) on the occasion of my paper on refractometers, it is pointed out that it had been observed that the Zeiss Abbe refractometer fails when measurements are required of liquids having an index exceeding 1·52. This Mr. Churcher stated to be due to the substitution of a crown prism of refractive index 1·52 for D in the place of the dense flint prism formerly used as lower or illuminating prism.

The fact that Messrs. Zeiss had changed their procedure with regard to the material of this lower prism in certain instances was of great interest to me, and I have been on the look-out for an instrument having the singularities described. Hitherto I have been unable to find any Zeiss refractometer having the defect mentioned.

If, therefore, any other of your readers possess such an instrument, I should be greatly obliged if they would let me know; and if they are aware of any special purpose for which the instrument should have been so made, I should greatly appreciate it if they would communicate the information to me.

F. SIMEON.

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75A Camden Road, N.W.1.

British Thermometers.

IN an article printed in the catalogue of the British Scientific Products Exhibition (p. 47) I directed attention to the fact that Beckmann thermometers of British make were not then procurable. It will interest scientific workers to know that good thermometers of this type are now manufactured in this country, and may be procured through the ordinary dealers.

CHAS. R. DARLING.

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RESEARCH ON HEALTH AND DISEASE.

THE outbreak of influenza has directed attention to what ought to have been sufficiently clear before—namely, the vital necessity for much more attention being given to the provision of adequate scientific inquiry into the causes of diseases. The question, indeed, is all one with that of research on other scientific problems, and most of the remarks that follow apply, with the appropriate changes of titles, to scientific investigation in general.

The provision for matters relating to disease is closely linked with the establishment of the proposed Ministry of Health. Although a part of the activity of such a body would be the important one of co-ordinating the various departments and authorities connected with the health of the nation, it would be a fatal defect if the equally important one of making full and generous provision for advance by systematic research were left out of sight. Since the functions of the Ministry of Health must of necessity demand the assistance of many and various branches of science, it would seem that those at its head should be men of the widest knowledge and sympathy. It is doubtful whether it would be the wisest thing for the Ministry to be given over entirely to the medical profession, as has been assumed in some quarters. The medical profession would, of course, be largely represented, but the most effective way of getting work done on any particular problem would be to appoint a special committee consisting of heads of laboratories and representatives of institutions where similar research is being carried on. These men would be in touch with the capacities in existence and the capabilities of those actually at work. Such committees should be able to advise the granting of funds by the various bodies having them at their disposal, such as the Department of Scientific and Industrial Research, the Medical Research Committee, and so on.

It is a question whether the Ministry of Health need itself finance research. The multiplication of departments doing this is apt to lead to overlapping and to waste of valuable resources. The grants made on the advice of the committees suggested above might well be limited to the payment of actual laboratory expenses, inclusive of assistance when necessary. The really important thing is that there should be men always at work and ready to take up problems of urgency when they appear. It is unnecessary in this place to insist on the fundamental importance of what is often called abstract research in science. It is but rarely that work directed to a definite limited practical object leads to really valuable permanent results. Take the case of influenza. The mere knowledge that the disease is associated with the presence of Pfeiffer's bacillus is not enough. We must know the conditions which are favourable to the growth and virulence of this organism, and again what changes in the body render it a prey to the attacks of this and other agents. All this implies a far greater knowledge of the general biology of micro-organisms and of the physiology of the animal body than we yet possess. Researches of this kind must always be provided for and in continuous, uninterrupted course. They lead to direct practical applications, frequently making special investigation unnecessary, or at least rendering such work comparatively simple.

But, as is universally agreed, the number of such workers at the disposal of the nation is grievously inadequate. Why is this the case? There can be no doubt that it is due to the fact that no permanent careers in sufficient number are open to men who are attracted to research work, especially when of a character not directly connected with immediate practical applications. This must be remedied and without delay. In that branch of science with which the writer is more particularly acquainted, it often happens that a man with talent for research is obliged to devote himself to medical practice because he can see no reasonable prospect of a future career to support himself and his family. The only way to remedy such a state of affairs is to provide permanent research posts at an adequate salary. Grants for limited periods are of no real use, and the Beit fellowships, valuable as they are, are open to serious criticism in this respect. At the end of his tenure the holder is left stranded. There must be some security of tenure. No good work can be done under perpetual anxiety for the future. To a very large degree the need could be most effectively met by liberal grants to universities and other teaching institutions to enable them to increase their staff and the salaries paid on condition that at least half time was free for research. At the same time, the teaching itself would greatly benefit and class fees could be reduced to limits permitting all capable of benefit to obtain it, while the performance of some amount of teaching is of value in preventing too narrow an outlook, of which there is danger in the pursuit of what must, of necessity, be a more or less limited objective. The money must be at the disposal of the university, since only their colleagues can possess satisfactory knowledge of the capabilities of the staff. Of course, inspection would be advisable and profitable.

However this may be, there can be no doubt of the urgent and vital necessity for the generous provision in some way of permanent adequately paid posts for men who wish to devote their lives to research. We have every reason to be proud of our achievements in pure and applied science, but how much greater might they not have been if the services of so many talented workers had not been lost in the past?

One aspect of the matter must be insisted upon. The demands of those unacquainted with the nature of scientific work suggest that they expect, say, a cure for influenza to be discovered in a week or two. It must be made clear that no accurate scientific work can be done in haste. If inaccurate, it is worse than useless, because it misleads and often results in the loss of much later work based on it. A great advantage of work carried on without the limitation of a direct practical object is that the most promising course of investigation often reveals itself in the actual progress of the work itself, so that the most valuable result may be quite different from the problem originally attacked.

At the present time there are special circumstances that require attention. The number of men trained in scientific methods has not only been reduced by death during the four years of war, but the outlook for the future is serious on account of the gap of four years in the training of men who should have been available now. It will be difficult or impossible for many of those returning from military service to devote three or four years to training at an age when it may be necessary for them to be earning a livelihood. It would seem to be a question for serious consideration whether some provision in the nature of scholarships should not be made to enable those who desire it to continue their scientific training. The funds necessary might with reason be regarded as forming a part of the cost of the war to be paid by the enemy.

W. M. BAYLISS.

WAR-TIME BEEF PRODUCTION.

OF the many changes imposed by the war upon British agriculture, few have aroused greater misgivings amongst practical men than the restrictions imposed upon meat production by the reduction of supplies of imported feeding-stuffs. During the many years of abundant and cheap supplies of these materials before the war it became the normal practice of the cattle-feeder to feed lavishly with the view of turning out the fat beeves of prime quality which have always been the special pride of the British farmer. The economy of the practice was frequently called in question, and results of experimental investigation were not wanting to supply evidence that the standard of feeding which represented the upper limit of economy was not very high. Recent controversies, however, have revealed how little practice had been affected by the teachings of the economist before the shrinkage of food supplies occasioned by the war rendered so-called "high" feeding physically impossible.

Before the war a daily allowance of 8 lb. to 10 lb. of "oilcake" per head was quite usual, so that it is little wonder practical men were seriously alarmed last winter when the fiat went forth that the available supplies of feeding-stuffs would not provide more than 1 lb. to 2 lb. for the purpose. That such a drastic reduction in the food ration must result in a great decrease in meat production and the disappearance of all but inferior qualities of beef was regarded in practical circles as self-evident. Even the scientific adviser of the farmer, though less pessimistic as to the magnitude of the effect, found himself very inadequately equipped with data which would enable him to assess the probable meat output on the restricted diet. The matter being so obviously of great economic importance, steps were at once taken to secure trustworthy information, and during the winter of 1917–18 experiments on a considerable scale were carried out under the auspices of the Boards of Agriculture for England and Scotland, and the Irish Department of Agriculture. The results of these experiments are now available in a summary prepared by Prof. T. B. Wood, and published in the August issue of the *Journal of the Board of Agriculture*. The experiments were carried out at two English, two Scottish, and three Irish centres with groups of eight to twenty cattle at each, a total head of ninety-five cattle being included in the tests. At each centre the cattle were given roots and straw *ad lib.*, supplemented with only $1\frac{1}{2}$ lb. per head per day of undecorticated cotton-seed cake.

With the lavish feeding of peace-time, cattle of the type used would commonly increase in weight at the rate of about 12 lb. to 20 lb. per week. In these experiments the average weekly gains at the different centres ranged from 6 lb. to 17 lb. per week, five of the results falling within the narrow range of 8 lb. to 10 lb. per week. The proportion of dressed carcass to live weight was certainly not up to the 60 per cent. of the prime fat steer, but at an average of 56 per cent. was still high enough to secure a place in the first grade of quality. What these figures mean in terms of beef output is demonstrated by Prof. Wood by a comparison with the results of pre-war experiments, from which it would appear that the decrease in oilcake consumption from 8 lb. to $1\frac{1}{2}$ lb. per head per day only reduces the liveweight increase by 3·3 per cent., and the meat output by 9 per cent. The results show further that from the point of view of profit the high cake ration would assuredly be a mistake at the present time, since for each extra pound of beef produced 13 lb. of cake costing about 2*s.* would be consumed.

Even more far-reaching conclusions as to the desirability of aiming at a lower stage of fatness in beef production under present conditions are arrived at by Mr. K. J. J. Mackenzie and Dr. F. H. A. Marshall from investigations of which a summary is given in the September issue of the same journal. These conclusions are based upon data obtained with ninety-two beasts of different degrees of "ripeness" specially selected for the purpose, weighed and slaughtered under conditions permitting of exact observation. The observations were extended further to the edibility of selected portions of the carcass and the proportion of waste involved in their consumption. From the data obtained the conclusions are drawn that the ordinary method of judging the condition of a beast by "handling" may often lead to serious errors of judgment as to its fitness for the butcher, generally resulting in far too many beasts being kept beyond the most economic time for killing; that beyond a certain point further increase in weight does not contribute effectively to the meat supply, being mainly waste fat; and that no serious complaint on the ground of quality can be brought against the meat from the half-fat beast, the consumption of which is attended with the minimal quantity of waste.

On certain points of detail the practical man will doubtless find these observations not entirely convincing, but the general support they afford to the policy of retrenchment in cattle-feeding can scarcely be questioned. C. C.

STATE ASSISTANCE TO THE DYE INDUSTRY.

A MEMORANDUM (Cd. 9194, price 2*d.*) has just been issued by the Board of Trade giving details of the scheme for the allocation and administration of the funds provided by Parliament for assistance in the development of the dye industry. It is pointed out that the primary object of the financial assistance to be given is to make the British textile users of dyes independent of German dyestuffs, and to enable the manufacturers to bring down the cost of production to a point at which competition with the large-scale industry of Germany will be commercially possible. Loans and grants of money are to be given to assist in the provision of buildings and plant, and for the maintenance of a system of research. These funds are additional to and independent of the moneys already advanced to the firm known as British Dyes, Ltd. There are dyes which at the present time are not being manufactured in this country at all, or are being made in quantities insufficient for the reasonable needs of dye users, and in this direction especially encouragement is needed.

As to the work of research distinct from the technical routine of manufacturing operations, it is now recognised as an inherent part of the industry, and that it properly enters into the cost of production, since experience shows that in normal times a constant flow of new colours or varieties of colours is necessary for the maintenance of those dye-using trades which are subject to outside competition. It is also acknowledged that, while continued research must be carried on, it does not follow that commercial advantages may be immediately secured. The administration of the scheme will be carried out by (1) a loan and grant committee, (2) a trade and licensing committee, (3) an inspector of research, and (4) an inspector of accounts.

The business of the trade and licensing committee will be to determine what colours and intermediate products shall be licensed to be imported into the country after the war, and in what quantities, and to advise the Commissioner as to the colours and intermediates the manufacture of which should be specially encouraged, and the order of their importance. The committee will consist of four representatives of colour users and four representatives of dye manufacturers under an independent chairman appointed by the Board of Trade.

The inspector of research will occupy an important and somewhat difficult position. It is obvious that he must be a highly qualified "organic" chemist with special knowledge of the production of intermediates, as well as dyes. By his reports to the Dye Commissioner he will practically control the work that goes on in all the research laboratories connected with the works, and as the connection between the experiments actually in progress and the ultimate bearing of the results on industrial operations is often not very obvious, a good deal of patience and discretion will need to be exercised.

Conditions relative to the rate of interest to be charged on loans and the amount to be set aside for depreciation and obsolescence of plant and buildings, as well as for the repayment of the loans, are set forth in the memorandum.

COMMERCIAL AVIATION.

THE subject of commercial aviation is one that has attracted a great deal of attention during the latter phases of the war, and now that hostilities are at an end it has become a matter of the first importance. A vast organisation has been created in order to provide the necessary machines and men for the needs of the Royal Air Force, and it seems almost certain that the full military output of which we are now capable will not be required in times of peace. If, however, aviation is to take a prominent place in the commerce of the future, an outlet will be at once found for the energies of designers and manufacturers of aircraft.

There are many indications that the aeroplane will soon become an important factor in international trade, though it is at present impossible to forecast the extent of such developments. The *Times* of November 15 reports that Mr. Holt Thomas intends to institute a passenger service between London and Paris as soon as circumstances permit. Machines that had been designed for bombing work over German territory are to be used, and it is hoped to make the complete journey in three hours and a half, the actual flying time from aerodrome to aerodrome being two and a half hours. The price of the tickets will be fifteen guineas per passenger, and the service will be a daily one, weather permitting.

Close on this announcement comes the news that a record flight has been made over London by a Handley-Page machine carrying forty passengers, together with fuel for a six hours' flight. This remarkable achievement, in which the previous record number of passengers has been doubled, should do much to convince the sceptic of the possibility of an effective aeroplane passenger service. It appears likely, however, that one of the greatest commercial uses of the aeroplane will be the carrying of international mails, where the increased speed of transit would be a great asset to commercial activities.

The *Times* of November 16, which reports the above record passenger flight, also gives an account of a speech by Lord Weir, made at the opening of the exhibition of enemy aircraft at the Agricultural Hall. Lord Weir, in referring to commercial aviation, expressed his opinion that while the possibilities are great, the probabilities are not so great. A period of pioneer work must be expected, and he hoped that the State would be able to render much assistance to those manufacturers whose thoughts were turned to the new problems involved. It is earnestly to be hoped that such will be the case, and there seems little doubt that if our unique facilities for aeronautical experiment and research can be applied to the new problems of commercial aviation, the pioneer period will not be a very long one, and results of great importance will soon be reached. The development of aerial intercourse between the nations should do much to keep them in closer touch one with another, and thus aid in the world's progress towards the desired goal of universal peace.

NOTES.

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received the King's approval:—The Copley medal to Prof. H. A. Lorentz, For.Mem.R.S., for his distinguished researches in mathematical physics. The Rumford medal to Prof. Charles Fabry and Dr. Alfred Pérot (jointly) for their contributions to optics. A Royal medal to Prof. Alfred Fowler, F.R.S., for his distinguished researches on physical astronomy and spectroscopy. A Royal medal to Prof. F. G. Hopkins, F.R.S., for his researches in chemical physiology. The Davy medal to Prof. F. S. Kipping, F.R.S., for his studies in the camphor group and among the organic derivatives of nitrogen and silicon. The Darwin medal to Dr. H. F. Osborn for his valuable researches on vertebrate morphology and palæontology. The Hughes medal to Mr. Irving Langmuir for his researches in molecular physics.

WEATHER information is now again allowed to appear in the columns of the newspaper Press, and the Meteorological Office has, from last Monday, resumed the issue of its official forecasts. It must necessarily be some time before the circulation of the various weather reports is in pre-war order. By the action of the Government the issue of much of the ordinary weather information was suspended at the end of September, 1914, and from May 1, 1915, the Meteorological Office ceased to issue weather forecasts; for some time afterwards, so far as current weather is concerned, only the observations of sunshine, rainfall, and temperature from the health resorts were issued, and these, after a short period, were also stopped. The action was taken in order that no useful hint should be given to aid Germany's air-raids. During the last few months of the war the censorship of the weather was so severe that no mention of the weather was allowed in the newspaper Press. The Weather Office has contributed information of the highest value to the Air Service, Navy, and Army throughout the period of the war. There is an opportunity now for much greater usefulness than prior to the war, and information will doubtless be eagerly sought for by the aerial services. If a journey to India is undertaken by aircraft it would probably be fairly ideal in the summer, the surface winds being favourable, and by passing over the Arabian Sea use can be made of the area of low barometric pressure situated over the northern portion of India. In the winter, however, the strong southerly surface winds blowing round the high-pressure area over Asia would be embarrassing, and probably the upper-air current would prove more favourable. Meteorological problems will have to be grasped by the flying experts, and knowledge gained relative to the upper air must be made public, just as in the past the seaman has acquired knowledge of air and sea currents at the sea surface.

WE sympathise with Lord Sudeley's protest, in a letter to the *Times* of November 15, against "such a long delay as six months being permitted to elapse before our museums are once more at full swing." The sooner they resume their full activities of acquisition, investigation, and instruction, the better. It is with elementary and popular education that Lord Sudeley is chiefly concerned, and he rightly directs attention once again to the presence of our soldiers from the Dominions, and we would add those from the United States, so many of whom wish to see these great institutions. Yet if Lord Sudeley thinks that a return to peace conditions can be "a matter only of weeks," he is over-sanguine. It is easier to pull down than to build up, and, even with a full staff, the replacement of the numerous objects that have been removed—some to considerable distances—with their proper ordering and labelling, would take months rather than weeks. But the staffs are not complete; many men will never return; many cannot yet be spared from their military and other national duties. Their work cannot be done by new and untrained men, still less by stopgaps. None the less, the task of restoration is already in progress: the Science Museum was reopened some weeks ago; the British Museum has arranged a war-time exhibition, really all the more pleasant for being not quite so overwhelming. Let us progress steadily, but let us progress surely and strongly. It is not to pre-war conditions that we hope to see a return. We must go further forward. Above all things, increased staffs are demanded if our museums are to fill that place in national reconstruction which they are in other respects both fitted and anxious to fill.

PROF. DAVID E. LANTZ, assistant biologist on the Biological Survey, U.S. Department of Agriculture, died of pneumonia on October 7 at Washington, D.C. He was chiefly engaged in investigations of the economic relations of mammals.

MR. WM. B. BRIERLEY, of the Pathological Laboratory, Royal Botanic Gardens, Kew, and formerly lecturer in economic botany to Manchester University, has accepted the appointment of mycologist to the new Institute of Phytopathological Research, Rothamsted Experimental Station, Harpenden.

THE *Times* correspondent at Stockholm announces that the Swedish Academy decided on November 11 to award the Nobel prize for physics for the year 1917, in reserve from last year, to Prof. C. G. Barkla, professor of natural philosophy in the University of Edinburgh, for his work on X-rays and secondary rays. The prize in physics for 1918 and that in chemistry for 1917 and 1918 have been reserved.

WE are informed that new and unexpected claims of his profession have made it impossible for Mr. H. M. Langton to undertake the office of secretary of the National Union of Scientific Workers. The executive committee has therefore decided to leave the office vacant for the time being, and has appointed Dr. Norman R. Campbell chairman of the executive, and Mr. Eric Sinkinson assistant secretary. All correspondence should be addressed to the assistant secretary at 14A Albert Bridge Road, S.W.11.

IN view of the alarming and contradictory reports of the present epidemic of influenza that have appeared in the public Press, the Royal College of Physicians of London has issued an authoritative memorandum in the public interest. It is considered that the present epidemic is essentially identical with previous epidemics. It is suggested that the causative virus may be a micro-organism beyond the range of microscopic vision, but the present epidemic has no relation to plague, as some have suggested. Valuable hints are given with regard to prevention and to general treatment if infection occurs, and it is stated that no drug has yet been proved to have a definite preventive or curative action.

INFLUENZA continued to maintain its virulence over England, according to the Registrar-General's return for the week ending November 9, but the general deaths seemed to warrant the assumption that the epidemic had reached its climax, and there appears a good prospect that it is on the wane. For London the deaths from influenza were 2433, which is 25 fewer than for the week ending November 2. The deaths for the respective ages were from 0 to 5 years, 13 per cent.; 5 to 20 years, 17 per cent.; 20 to 45 years, 50 per cent.; 45 to 65 years, 14 per cent.; 65 to 75 years, 4 per cent.; and above 75 years, 2 per cent. In the five weeks ending November 9 the total deaths in London from influenza were 6508, of which 6147 occurred in the last three weeks. In the whole five weeks of the epidemic the influenza deaths compared with the total deaths from all causes were for ages 0 to 5 years, 36 per cent.; 5 to 20 years, 65 per cent.; 20 to 45 years, 67 per cent.; 45 to 65 years, 37 per cent.; 65 to 75 years, 21 per cent.; and above 75 years, 10 per cent. The influenza deaths for the five weeks were 48 per cent. of the total deaths from all causes, pneumonia 12 per cent., and bronchitis 5 per cent. In Paris, with about three-fourths of the population of London, the deaths from influenza in the week ending October 26 were 1263, whilst in London, for the corresponding period, the deaths were 1256. The drier and much colder weather during the past week may tend to the disappearance of the epidemic.

DR. AUGUSTUS F. R. HOERNLE, C.I.E., the eminent Oriental scholar, died at Oxford on November 12, aged seventy-seven years. He was attached to the Church Missionary Society at Meerut from 1865 to 1870, when he was appointed principal of the Cathedral Mission College, Calcutta, and afterwards principal of the Calcutta Madrasah. He acquired a wide knowledge of Sanskrit and Hindi, and his "Comparative Grammar of the North Indian Languages" and his "Comparative Dictionary of the Bihari Language" are works of authority, used to much advantage by Sir G. Grierson in his linguistic survey of India. Dr. Hoernle paid much attention to the medicine of ancient India, and his most important works were his translation of the birch-bark codex discovered by Col. Bower at Kucha, in Khotan, in 1890, and his report on the MSS. collected by Sir Aurel Stein and other explorers in Chinese Turkestan. The death of this eminent philologist is a serious loss to Oriental learning.

WE derive from the Meteorological Office Circular No. 29 the following particulars of the work of Dr. Walter de Watteville, who died on October 3 at sixty years of age:—Dr. de Watteville was a native of Berne, Switzerland, and had been many years in practice at Kingussie. He was one of the earliest supporters of the open-air treatment for the cure of tuberculosis, and was the director of a sanatorium where much valuable work has been done. Keenly interested in various departments of science, Dr. de Watteville had since 1895 maintained a second-order station at Kingussie, more than 800 ft. above sea-level. We owe entirely to his enthusiasm a satisfactory set of climatological normals for Upper Speyside, and a demonstration of the fact that this region, which has long been popular as a summer resort, affords, even amidst the rigours of a Highland winter, an atmosphere eminently favourable for the treatment of tubercular complaints.

WE learn from *Science* that Mr. Henry Suter, author of "A Manual of the New Zealand Mollusca," who died in Christchurch, N.Z., on August 1, was born at Zurich in 1841, and went to New Zealand in 1886 to engage in farming, but soon relinquished the idea, and devoted most of his time to studying the indigenous mollusca of the antipodean country. In 1913 he produced his "Manual," which was published for him by the New Zealand Government. It contains the diagnoses of 1079 species, 108 sub-species, and 100 varieties of New Zealand molluscs. Two years later the Government published his atlas to the "Manual." This has seventy-two plates, containing many figures of molluscs from Mr. Suter's own drawings. In later years he gave special attention to Tertiary molluscs of New Zealand, and in 1916 the Geological Survey Department published as a bulletin a work by him on "The Tertiary Mollusca of New Zealand." His death leaves New Zealand without a recognised conchologist.

IN view of the success which has attended the fortnightly conferences and discussions now being held by the Industrial Reconstruction Council, a second series has been arranged for January, February, and March of next year. The first conference, under the title of "Reconstruction or Restoration?" will deal with the general principles which should guide us during the difficult transition period, and will be opened by Major H. J. Gillespie on January 14. The other meetings will discuss "The Workers' Interest in Costing," "The Place of the Merchant in British Industry," "Welfare Work," "Wages and Conditions of Employment in Relation to Future Industrial Prosperity," and "Industry and Educational Reconstruction." No tickets will be issued, but all those who intend to be present are asked to inform the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4, who will be glad to send a full prospectus of the series on application.

THE British Scientific Instrument Research Association, one of the earliest associations formed under the scheme of the Department of Scientific and Industrial Research, has secured premises at 26 Russell Square, W.C.1, where offices and research laboratories will be equipped. The first chairman of the association was Mr. A. S. Esslemont, whose recent lamented death has been a severe loss to the association. The council has elected Mr. H. A. Colefax, K.C., as chairman to fill the vacancy. The vice-chairman is Mr. Conrad Beck, to whose energy and personal influence is largely due the successful formation of the association. Almost all the leading optical and scientific instrument manufacturers are members. The Department of Scientific and Industrial Research is represented by Major C. J. Stewart, Capt. F. O. Creagh-Osborne, R.N., Mr. S. W. Morrison, Col. R. E. Home, R.A., and Mr. Percy Ashley. The council has recently co-opted as members of its body the Hon. Sir Charles A. Parsons, F.R.S., and Prof. J. W. Nicholson, F.R.S. Sir Herbert Jackson, K.B.E., F.R.S., has been appointed director of research, and Mr. J. W. Williamson secretary of the association.

MR. WILLIAM LLEWELLYN PREECE, the eldest son of the late Sir William Preece, whose death, at the age of fifty-two, occurred in London on November 10, was educated at King's College School and the Hanover Square School of Electrical Engineering. In 1898, after having spent twelve years in the Midland Railway Co.'s telegraph department, he joined his father's firm (now Preece, Cardew, Snell, and Rider) as a consulting engineer. Sir William Preece had for many years previously held the appointment of consulting engineer to the Crown Agents for the Colonies, and Mr. Preece on joining the firm took charge of the branch of the practice dealing with telegraph and telephone matters in the principal Colonies and Dominions, including those under the Crown Agents and High Commissioners for South Africa and New Zealand. He had made a special study of wireless telegraphy, and was responsible for the wireless plant established in many of our distant Colonies; he was one of the expert witnesses examined by the Select Committee of the House of Commons appointed to inquire into the Post Office contract with the Marconi Co. for the proposed stations of the Imperial Wireless Chain. At the time of his death Mr. Preece held a commission in the R.N.V.R., and was employed at the Admiralty. He was a member of the Institution of Civil Engineers and also of the Institution of Electrical Engineers, and was serving on the council of the latter body at the date of his death. He read a paper in 1915 before the latter body on "Telephone Troubles in the Tropics," and had also at various times written many papers on Church matters, in which he was deeply interested, for private circulation.

SIR HERMANN WEBER, the distinguished physician, who died on the day of the signing of the armistice, was in his ninety-fifth year, and had practised in London for three-quarters of a century. He was a true lover of England; his desire was to live to see the victory of the Allies and the end of the war. To those who knew him he represented the very best and most beautiful aspect of that Germany which was. He died as gently as he had lived. He was one of those rare men whose lives are made up of all friends and no enemies; and that, not because he was negative or poor-spirited, but because he was honourable, courteous, pure in heart, unselfish. He was a man of culture and a great collector of Greek coins, and was known as an expert on this subject. Above all, he was a wise and far-seeing adviser. It was he who taught us the saving power of the Engadine for consumptive patients; he thus helped to bring about the open-air treatment of that disease. On questions of climate and of health resorts Sir Hermann Weber was the first, and one of the greatest, authorities in London. He was a member of the Alpine Club; he knew the meaning of fresh air; he was still an Alpine climber at eighty. He could still, in his ninety-fifth year, walk his seven or eight miles a day, walking fast, and preferring to walk bareheaded. He was in that splendid circle of Victorian physicians and surgeons whose names are as household words to many of us; he outlived them all. His length of days is not to be ascribed to any force of abstinence; he was "anti" nothing; merely, he lived a very temperate, diligent life. The secret of longevity is not altogether explicable; we live so long as we were originally wound up to live. But we may at least believe that peace of mind and a quiet enjoyment of the very best sort of things have something to do with a man's continuance.

MR. W. AIRY has published an interesting paper entitled "On the Ancient Trade Weights of the East." His object has been to present a simplified account of the ancient weights of the East, not including those of China and Japan, and to illustrate their inter-relations. He finds that practically all Eastern weights may be referred to one or other of the following systems:—The Egyptian kedet system, based on a kedet of 140 grains; the Egyptian shekel system, based on a shekel of 245 grains; the Phœnician shekel system, based on a shekel of 220 grains; the Babylonian and Assyrian systems, based on a shekel of 254 grains; the Greek Æginetan system, based on a shekel of 254 grains; the Greek Solonian system, based on a drachma of 67·5 grains; and the Roman system, based on a libra of 5050 grains.

MESSRS. G. A. NATESAN AND CO., Madras, have issued short biographies of two well-known Indian men of science, Sir J. C. Bose and Dr. P. C. Rây. The former, after receiving some elementary education at a Bengali "patshala," or village school, went to Christ's College, Cambridge, and there laid the foundations of the scientific training which led to his investigations of the transmission of excitations in plants like the mimosa, developed in his important work on "Plant Response." Dr. P. C. Rây was trained under Tait and Crum Brown at Edinburgh, and became professor of chemistry at the Presidency College, Calcutta. His most important work has been the foundation of an Indian chemical school and the establishment of the Bengal Chemical and Pharmaceutical Works, now a flourishing concern. It is well that these two men of science are at hand, qualified to assist in the industrial development of India, which cannot now be long postponed.

SOME interesting notes by Mr. E. C. Chubb on the whales landed at the whaling station at Durban appear in the Annals of the Durban Museum (vol. ii., part 2). These were taken during the whaling season of 1914, since when, unfortunately, the "fishing" has been suspended, though it will be resumed, no doubt, at no distant date. A female of the blue whale (*Balaenoptera musculus*) is recorded here which was 90 ft. in length, and it is evident that, for the present, some uncertainty must obtain in regard to records of the capture of the "seihval" (*B. borealis*), since this species is not readily distinguished from the South African *B. brydei*. From the stomach of a sperm whale, obtained off Durban in 1913, a shark, 10 ft. in length, was taken. A number of excellent photographs add much to the value of this paper.

THE Monilia diseases of fruit-trees are some of the most serious of those with which present-day fruit-growers have to contend. In spite of the considerable amount of work which has been done on them, our knowledge of their specific symptoms and detailed etiology has remained to a considerable extent incomplete. During recent years, however, thanks to the careful work carried out at Wye College by Mr. E. S. Salmon and Mr. H. Wormald, important advances have been made in the elucidation of these diseases. In the *Annals of Applied Biology* (vol. iii., No. 4) Mr. Wormald published the results of a very thorough study of a blossom-wilt and canker of apple-trees due to a species of Monilia clearly different from *M. fructigena* (the cause of the well-known rot of apples), which he refers to *M. cinerea*, Bon. More recently Mr. Wormald has published in the same journal (vol. v., No. 1) an equally illuminating account of a "wither-tip" disease of plum-trees which occurs in Kent, and probably elsewhere. This disease is also caused by *M. cinerea*. The interesting point is that, although the two fungi which attack apple- and plum-trees respectively are morphologically indistinguishable, yet their pathogenic characters are dissimilar. Hence it is now proved that amongst the Monilias, just as amongst the "rusts" and the "mildews," biologic forms or physiological strains exist. In the case of the two Monilias referred to, these strains can be distinguished, not only by their behaviour with regard to specific hosts, but also by means of cultural and biochemical methods.

THE regulations for the supply of spectacles to the German Army have given a great impetus to the general desire to carry standardisation of spectacle parts still further. According to the *Central-Zeitung für Optik und Mechanik* (August 20), military spectacles must have lenses of 38·2 mm. diameter and be interchangeable. Only ten types are permitted. Standardisation is still desirable in frames, screws, etc., of which only one size should be permitted.

A WRITER in *L'Elettrotecnica* for September 25 pleads for an intensive system of re-afforestation in Italy in view of the future industrial requirements of that country. It is suggested that suitable trees be planted in the neighbourhood of watersheds for the production of charcoal by electric power, as Italy may be obliged to have recourse to charcoal in place of coke for steel-making. Some figures are given showing the power required and the yield of charcoal and by-products possible.

PAPER yarn of from 1 to 5 mm. diameter is in use in Germany as a substitute for jute. Paper yarn from parchment paper is woven into belts for driving light machinery. According to *Zeitschrift für angewandte Chemie* for August 2, when treated with 1 per cent. solution of tannin the yarn is rendered soft and flexible to the touch and its strength increased by 49 per cent. The addition of gelatine gives a hard, firm touch to the yarn and an increased strength of 25 per cent. When wet its strength is reduced by only 15 per cent. Neutralised aluminium acetate added to the tannin solution gives the yarn a strong, elastic touch and increases its strength 44 per cent. The average water-content of the yarn is about 38 per cent.

Elektrotechnische Zeitschrift for August 20 gives particulars of a number of new scientific institutions in Germany to improve the methods of using raw materials for industrial and war purposes. The Kaiser Wilhelm Institute for Research on Iron will deal with scientific research on iron. An institute bearing a similar title will deal with the selection of suitable research workers and the provision of grants to enable them to carry on their work. There is a further institute for biological science. A research institution for lignite and mineral oil is attached to the Technische Hochschule, Berlin, towards the cost of which 750,000 marks have been subscribed; while a parallel institute has been affiliated with the Royal Mining Academy of Saxony, the work at which will include research on ferro-alloys and calcium carbide. The Kaiser Wilhelm Institute for Military Science will work in conjunction with the best scientific and military experts to promote the development of science and technology for war purposes. There will be sections for chemical raw materials for munitions, chemical war materials (powder, explosives, gases, etc.), physics (which will include ballistics), technical methods of transportation, aeronautics, etc. South German textile manufacturers have founded an institution for textile research. Present investigations at this institution are concerned with all kinds of paper, cellulose, and fibres for textile purposes.

THE September issue of the Proceedings of the Tokyo Mathematico-Physical Society contains a paper by Mr. M. So on some interesting observations he has made in the physical laboratory of the Tokyo Electric Co. on the annealing of glass. In the first instance a newly drawn glass fibre is heated slowly in an electric furnace and its length observed. It increases as the temperature rises, but at a temperature in the neighbourhood of 400° C. it begins to contract, and at about 500° C. becomes plastic. Next, when a short cylinder of the glass between crossed Nicols is heated, the interference rings show little change until a temperature of 400° C. is reached, and then widen and disappear at about 500° C. Lastly, when the glass is slowly heated or cooled, the curve of temperature change shows that over the plastic range of temperature there are absorption and liberation of heat, proving that some change of state of a constituent of the glass takes place at that temperature. The first two effects vary with the nature of the glass, and are not exhibited by annealed specimens. The third effect is found in both annealed and unannealed glass.

IT is well known that the changes effected in the surface of glass that can be revealed by the deposition of moisture or by using the glass as the basis of a photograph, and in other ways, are sometimes very persistent. Mr. J. H. M. Davidson, of Adelaide, records in the *British Journal of Photography* for November 1 a "To Let" notice originally painted in whiting and water that has survived for more than twenty-five years, in spite of the window-cleaning that it has been subjected to. He suggests that the effect is due to molecular changes. Mr. Julius Rheinberg says that his experiments "made during the last years on the introduction of metals into the surface-layer of glass have convinced him more and more that we should regard glass as a substance full of *ultra-microscopic* pores." He suggests that material left in these pores, which would sometimes resist cleaning processes, may form the nuclei or condensation centres when the latent image is rendered visible. Mr. Rheinberg is well known among men of science interested in microscopical and photographical matters, and as he is the maker of the graticules and micrometer and other scales exhibited at the British Scientific Products Exhibition recently arranged by the British Science Guild, his opinion is of special interest. Some of these scales, etc., have the gradations made photographically in untarnishable metal *in* the surface-layer of the glass itself, and thus need no cover-glass to protect them.

THE stoppage of supplies of organic developing agents from Germany led to the supply of many "metol substitutes." Several of these have been examined in the research laboratory of the Eastman Kodak Co., and they have communicated their methods of analysis and some typical results to the *British Journal of Photography* for November 8. Some contained a small proportion of metol. One contained metol 10 per cent., hydroquinone 18·5 per cent., the rest being cane-sugar and sodium sulphite. Another was simply pyrogallol with three times its weight of sodium sulphite. Some were boldly labelled "metol" without the word "substitute." Two such did not contain a trace of methylated product, though one was labelled "hydrochloride of methyl-*p*-amino-*m*-cresol, guaranteed 96·3 per cent. pure." Another was half hydroquinone, and contained sodium sulphite, potassium iodide, and sodium carbonate. Of developing agents that did not claim any special relationship to metol one was half starch and moisture. There is also given a long list of adulterants and useless additions that Dr. H. T. Clarke, the analyst, has found in various commercial developing agents. Although such stuffs as those mentioned may be on the market, there is no need to use them, because reputable firms are making the genuine developing agents and marketing them under their proper names. But it behoves those who use developers to be on their guard.

A FEW months ago Messrs. Pictet and Sarasin described the production of lævoglucosane by the distillation of cellulose or starch under diminished pressure. This body is of interest, since it can be converted into *d*-glucose and thence into alcohol. In *Helvetica Chimica Acta* (No. 3) M. Pictet shows that the reverse process is possible up to a certain point, lævoglucosane being readily transformed into dextrin by re-polymerisation. This change is brought about by simply melting the lævoglucosane in the presence of platinum black, which acts as a catalyst; the transformation is complete in a few minutes. As regards the product, this approximates to certain of the achroodextrins, but has a notably lower rotatory power. In the same number of the *Acta* there is another interesting instance of catalytic action. M. F. Reverdin shows that the benzoylation of certain aromatic derivatives is greatly facilitated by carrying out the operation in the presence of a small quantity of sulphuric acid. Resorcin, alizarin, amino-anthraquinones, and trinitro-*para*-anisidine are some of the compounds which can thus be readily benzoylated.

OUR ASTRONOMICAL COLUMN.

THE PLANET SATURN.—This attractive telescopic object is now coming favourably into view in the evening hours, rising on November 25 at 10h. 34m. and on December 25 at 8h. 35m. p.m. The southern surface of the rings is visible, but the angle subtended by the minor axis is growing less as the planet's motion is directed southwards.

Surface phenomena, of somewhat similar nature to those affecting Jupiter, are visible on Saturn, but are more difficult to detect, and probably less frequent in their manifestation. Further study of the markings is desirable, and especially with regard to their rates of motion in different latitudes. Mr. Denning writes that from a number of white and dark spots placed in the planet's north temperate zone in 1903 he deduced a mean rotation period of 10h. 37m. 56·4s. This differs considerably from the period ascertained from a white equatorial spot seen by Prof. Asaph Hall in 1876–77, which gave 10h. 14m. 23·8s. In 1793–94 Sir W. Herschel made some observations of certain inequalities in a southern quintuple belt on Saturn, and found the period 10h. 16m. 0·44s. If any spots or other irregularities in the belts are detected during the few ensuing months, their transit times across the central meridian should be taken with the view of redetermining the rate of rotation. During the remainder of the present year the planet will be in a position about 1½° from Regulus in Leo, and the configuration will be an attractive one for naked-eye observers.

THE ORIGIN OF COMETS.—Prof. Strömgren contributes an article on this subject to *Scientia* for August last. For some years past he has been studying the effect of planetary perturbations on those comets for which hyperbolic orbits have been found; his conclusion is that the excess of the eccentricity above unity can in all these cases be explained by the perturbations—in other words, that the primitive orbit was elliptical, and that the comets in question are original members of the solar system, not visitors from without. This conclusion is indeed fairly obvious *a priori,* since the relative velocities of the stars are of the order of several miles per second, and any body entering the sun's sphere of influence with such a speed would have an orbit of a decidedly hyperbolic character, whereas the eccentricity of the orbits in question is very little in excess of unity.

The remainder of the article is occupied by speculations on the cause of the prevalence of elliptical orbits of immense periods; the conclusion is that the matter now forming the planets and comets was formerly distributed as a diffused nebula over a region immensely larger than that bounded by the present planetary orbits, but excessively tenuous in the outer portions; any slowly moving fragments in these outer regions would approach the centre under gravity, their orbits being long ellipses, almost parabolic. Prof. Strömgren makes a novel suggestion to explain the absence of cometary matter in the interstellar spaces. It is now generally accepted that there is a tendency to equipartition of energy among the stars, the smaller masses having the greater speeds. On this view small cometary masses would attain such high speeds that they would be expelled from the stellar system; those alone would remain that were within the domains of individual stars.

MINOR PLANETS.—The fifth planet of the Trojan group, discovered last year and designated 1917 CQ, was reobserved by Prof. Wolf on October 5. Its magnitude was 14·5. Prof. Wolf has given it the name Priamus.

THE OCCLUSION OF GASES IN METALS.

On Tuesday, November 12, the Faraday Society held a discussion on the above subject, attended by a very representative gathering of the various aspects of it, theoretical and experimental. After a foreword by the president, Sir R. Hadfield, on the great war, the discussion was opened by Prof. Alfred W. Porter, who emphasised that the term "occlusion" includes, in reality, a number of phenomena: chemical combination, simple or compound solid solution, surface adsorption accompanying solution, surface condensation unaccompanied by solution, and inclusion of gas forming blowholes visible to the naked eye or microscope. The difficulty of distinguishing between these several types was illustrated by the case of the occlusion of hydrogen by palladium, the nature of which, even at the present day, is still an unsettled problem. Amongst phenomena due to occlusion are the passivity of iron and the associated fact of the embrittling of iron by caustic soda. But there are other phenomena of more theoretical interest, such as the Volta effect, which has often been attributed to condensed layers of gases. By the experiments of O. W. Richardson and of Langmuir on thermionic emissivity, the question of the origin of the Volta effect has been completely reopened.

In connection with the brittleness associated with occlusion in iron and other metals, the opener endeavoured to elicit an expression of opinion as to the nature of brittleness, illustrating his remarks with the well-known behaviour of cobbler's wax, which is exceedingly plastic under the action of small forces of long duration, but is as brittle as glass when struck a sharp blow. He laid stress on the necessity for paying attention to the time element in specifying brittleness.

Mr. Cosmo Johns followed on the technical side with a paper on the properties of metals as affected by their occluded gases. He distinguished between gases which are absorbed as such and those which are formed as a result of reactions between non-gaseous constituents during the cooling of the metals in question. It is known that molten copper and iron dissolve more hydrogen than when those metals are solid. A molten mass saturated with hydrogen at a particular partial pressure will, during freezing, become supersaturated with the gas. Some of this must be entrapped between the growing crystals and exist as macroscopic or microscopic gas enclosures, though this is probably not the only method by which occlusion occurs. Probably it is the inter-crystalline, amorphous matter that is chiefly concerned, and brittleness will be due to the change in this produced by the gas. He attributed the CO_2 and CO occluded to reactions between dissolved oxide of iron and the carbon in the steel at the particular temperature when iron oxide, being thrown out of solution as freezing progresses, becomes concentrated in the mother-liquor between the growing crystals and reacts with the carbon which has not suffered the same concentration. He urged that all our knowledge of the properties of metals merely relates to metals containing occluded gases, and not to pure metals themselves.

Dr. Thomas Baker gave a description of experiments made to discover the relation, if any, between the temperature of evolution of gas and the critical points of steel. He finds that with hard steels the evolution of hydrogen reaches a maximum rate at 600° C., and below this temperature constitutes the greater part of the gas given off. Carbon monoxide is slowly evolved from the beginning, and reaches its maximum rate at 688° C. With soft steel there is a further point of maximum evolution of hydrogen and carbon monoxide at 786° C.

Dr. McCance spoke on the balanced reactions in steel manufacture, particularly with reference to the open-hearth process. Dr. Hatfield pointed out the large influence which silicon has upon occlusion.

Dr. Rosenhain emphasised that all liquids are brittle, but, as the opener afterwards pointed out, it would be better to say all bodies. Mr. C. V. Boys, referring to the spitting of silver on solidification, stated that he had found that to avoid loss of silver through spitting in cupellation it was necessary to cool it very slowly; and he asked if this was due to the evolution taking place over a range of temperature, and not all precisely at the solidification point. It could not be due to differences of temperature in the solidifying mass, because a considerable amount of undercooling takes place, and the solidification, when it occurs, is a very rapid process, the whole mass rising practically instantaneously to the melting-point.

Sir T. K. Rose dealt with the bearing of Le Chatelier's principle upon the change of the concentration of dissolved gases with temperature. Prof. N. T. M. Wilsmore pointed out that he had recently observed that the diminution of solubility of gases with rise of temperature, so far as data go, is peculiar to water as solvent, and that, even in the case of water, there seems to be a minimum at a moderate temperature (see the data in the last edition of Landolt-Börnstein). This important observation is quite contrary to the belief usually held. The exceptional character of water may be attributed to the variation in its degree of association.

Prof. H. E. Armstrong laid stress on the artificiality of distinguishing dissolution from combination; dissolution *is* combination.

Dr. R. E. Slade directed attention to the bearing of the eutectic point of $Ag—Ag_2O$ at about 6° below the melting-point of silver; and Drs. Harker and Rayner described interesting experiments with very large masses of molten silver.

Dr. Gwyer was in doubt as to the reason for the proportionality of solubility in some cases to the square root of the pressure, apparently omitting to notice the bearing of the Nernst–van't Hoff law of distribution when the molecular association is different in the free and dissolved states.

Many other interesting points were made by various speakers. The openers reserved their detailed replies to the printed discussion, where these points will be dealt with.

GEOLOGY OF THE PERSIAN OILFIELDS.

An interesting paper on the geology of the Persian oilfields by Messrs. H. G. Busk and H. T. Mayo was read at the meeting of the Institution of Petroleum Technologists on October 15. Three areas are treated: the Bakhtiari country, in which the only oilfield worked as yet is situated; the Ahwaz-Pusht-i-Kuh country; and the Qishm Island and Persian Gulf region. The first of these is described in most detail. The rocks are divided into three series: The Asmari, Eo-cretaceous, at the base consists of massive limestones 2000 ft. or more in thickness. It is succeeded by the Miocene Fars series, more than 7000 ft. thick, divided into three groups: the lower, formed of some 3500 ft. of massive gypsum, shales, clays, and intercalated beds of detrital limestone; the middle, 1000 ft. of clays, shales, intercalated gypsum, limestone, and sandstone; and the upper, 2700 ft. of clays, shales, and intercalated red and brown sandstones. The Fars series is overlaid by the Bakhtiari series of Pliocene age, of which the lower group, 13,000 ft. or more of clays, sandstone, and conglomerate, is regarded as of lacustrine origin; and the upper, 2000 ft. of massive conglomerates, as torrential. The oil is found in the lower Fars group, the detrital limestones forming the reservoir; at Maidan-i-Naftun the wells all flow under strong pressure, and after ten years of remarkable production show no signs of exhaustion.

The geological history of the region seems to be one of extraordinary interest. The strata, from the base to the top of the Fars series, were deposited in a quiescent basin, and the thickness of beds between different horizons remains very constant. At the close of the Fars period folding began; the strata were thrown into open folds, and the overlying Bakhtiari series varies greatly in thickness, being thickest in the synclines, and least over the anticlines; towards the close of the period the synclines became filled up with sediment, and the upper Bakhtiari conglomerates spread over the whole. Then, according to the authors, a series of earth movements set in, continuing to the present and giving rise to a very complicated series of structures; fan, or, as they call it, Omega, structure was developed, and a series of thrust-faults which came right up to the surface and were partly determined by accidents of surface relief. In some cases the folds are completely overlaid by one overthrust extending beyond the next, and at Maidan-i-Naftun this is said to have been prevented only by the action of the Karun River, which flows for some miles in a gorge 800 ft. deep between the Tembi thrust-fault, which hades towards the oilfield on one side, and the back fault of the next fold, which hades in the opposite direction. The authors believe, in short, that the faulting and folding of this region were not only superficial, but also of recent date and continued, with a gradual relaxation, to the present day; they regard the surface features as largely due to the movements caused, to some extent, as determining this faulting, and consider that the advancing fronts of the overthrust blocks have been worn away by surface denudation, concomitantly with their advance by the action of the tectonic processes.

The Ahwaz-Pusht-i-Kuh region presents much the same features, with less intense disturbance; but in Qishm Island the identification of the rock series with that of the Bakhtiari country is doubtful, and the structure is very different, the rocks being disposed in a series of gentle domes along an axis running through the length of the island, these domes being subsidiary to a larger dome, exposing an inlier of the Eocene Hormuz series. Four explanations of this dome are discussed: that it is due to the intersection of two open folds of different dates, that it is of the same nature as the salt domes of Texas, that it is due to a laccolitic intrusion, and that it is due to the compression of the softer Miocene strata against a pre-existing boss of Eocene, round and against which they were deposited. No opinion is offered as to the relative probability of these, but the general features seem more in consonance with some cause analogous to the second and third, though the material to which the local uplift was due may have been neither salt nor a plutonic intrusion. Neither this nor the Ahwaz-Pusht-i-Kuh district has proved oil-bearing in a commercial sense, though indications have been found and both are being tested.

We may express a hope that, the absolute embargo on publication having been lifted, more of the large amount of geological information which is in possession of the Anglo-Persian Oil Co. and of the Indian Government may be made accessible. There can be no commercial reason for secrecy, as the company has a monopoly of the whole country, and the political reasons have been largely, and may soon be completely, removed. The value of publication will be great, as the region is one of extraordinary interest both in its structural aspect and as regards its bearing on the principles which underlie the origin and distribution of petroleum.

THE CONSTITUTION OF THE EARTH'S INTERIOR.[1]

THE problems of the interior of the earth are primarily of a physical character, and, in the final appeal, only to be decided by mathematical treatment; but this, in its turn, must be based on observation, and, therefore, it comes that this discussion is prefaced by a statement of the results which have been obtained by the sciences of observation. The preparation of this statement is simplified by the fact that the problems fall naturally into two tolerably distinct groups: (1) those relating to the outermost layer, amounting at most to 1 per cent. of the radius, and (2) those of the deeper portions, extending to the centre.

The latter may be taken first. Records of the transmission of mass waves set up in connection with earthquakes show two well-marked groups representing two forms of wave-motion, presumably the longitudinal and transverse, and a steady increase of the rate of transmission, with no very marked break in regularity, up to a distance of about 120° from the origin. Beyond that the first phase, of longitudinal waves, shows a decrease in velocity, and the second phase, of transverse waves, which, though so conspicuous at lesser distances, are no longer represented in their typical form, but are replaced by a record of different character, probably not due to any form of wave which has followed the direct path from the origin, and markedly delayed from the time at which they should have arrived had the same relative rate of propagation been maintained as at lesser distances. The depth reached by waves emerging at 120° from the origin is about half the radius from the centre of the earth, and the conclusion to be drawn is that down to that depth the material of which the earth is composed is sufficiently rigid against stresses of short duration, and sufficiently isotropic to permit the transmission of the two forms of elastic waves and to give rise to their separation by reason of the different rates of travel. Further, it seems that down to a depth of half the radius there is no marked change in the character of the material, but at greater depths there is a change in physical character to a material, or form of matter, which is no longer able to transmit the distortional waves, or, if capable, can only do so with a great diminution of intensity and at about half the rate in the lower layers of the outer shell; in other words, the material in the central nucleus has a very low degree of rigidity, even against stresses of only a few seconds' duration. The limit between the central nucleus and outer shell lies between four-tenths and five-tenths of the radius, measured from the centre of the earth; the transition between the two is apparently gradual, and not sufficiently abrupt to give rise to reflection of the waves at the junction of the two.

Turning to the outer layers, we have, next the surface, partly material which has been disintegrated by the processes of surface denudation, transported, deposited, and resolidified, and partly rock which has not undergone these processes, but is thoroughly cooled and solid in every sense of the word. These

[1] Synopsis of the opening of a discussion at a meeting of the British Association Geophysical Committee on November 19, by R. D. Oldham, F.R.S.

rocks have been subject to very considerable mass-movements and deformation, the displacements amounting in extreme cases to as much as ten miles in the vertical and one hundred miles in the horizontal direction. The ultimate cause of these movements is unknown; they can only be directly observed in the outermost skin, and are probably taken up in a different form in the deeper layers, but require that beneath the outer solid layer—which for convenience, and because some name is required, is commonly called the crust—there must be material which has some of the properties of a fluid, but not necessarily more than the power of change of form when exposed to stress of sufficient magnitude and duration. The thickness of the outer crust has been estimated by several distinct lines of deduction, all of which agree in giving a figure of about twenty-five miles, and this may be taken as indicating the order of its magnitude. The only means of arriving at any idea of the nature of the transition from the crust to the underlying material is in the reflection of earthquake waves; this is ordinarily treated as taking place at the surface of the earth, but there are grave difficulties in the way of accepting this interpretation. A more probable one is that reflection takes place at the under-surface of the crust, indicating a somewhat abrupt transition from the solid and rigid crust to the more yielding layer below. Whether this is a separate layer or merely the outermost part of the shell capable of transmitting both forms of elastic waves is still unknown.

The general result is that three distinct divisions can be recognised in the interior of the earth:—(1) The outer crust of solid matter possessing a high degree of rigidity, whether against permanent or temporary stress, of comparatively small thickness amounting to about ½ per cent., and not more than 1 per cent., of the radius; (2) a shell of material of thickness about one-half of the radius which has a high rigidity as against stress of the duration involved in the production of the tides, or of shorter duration, but, in the outer part at least, a comparatively low power of resistance to stress of secular duration; and (3) a central nucleus of material which has a very low degree of rigidity, even against stress of only a few seconds' duration. The transition from the first to the second of these three divisions is somewhat abrupt, sufficiently so to give rise to reflection; between the second and third the passage is more gradual, and lies at about four-tenths or five-tenths of the radius from the centre of the earth. These three divisions may be further reduced to two—the outer layer, which in geology is known as the crust, not from any implication of the nature of the rest of the earth, but merely in recognition of a difference in character; and the central core, consisting of the rest of the earth.

HYDRO-ELECTRIC POWER SUPPLY.[1]

LARGE works have been established for supplying Bombay with water-power for its numerous mills and factories, which have hitherto used steam-power, to the extent of more than 100,000 h.p. Coal in most of India is too expensive to allow competition with other countries for many products, though the raw materials are grown or found in India, and labour is cheap and docile, while highly educated Indians abound. To Bombay coal has mostly to be carried about 1200 miles.

The water-power now provided is very much cheaper than power from coal or oil, gives a better "drive," and frees Bombay from the clouds of deleterious smoke which the poor Indian coal gives.

The works take advantage of the very heavy rainfall on the precipitous edge of the Western Ghats, about 2000 ft. above, and about forty miles from, Bombay. As the rain falls only during three or four months of the year and the watercourses are dry all the rest of the year, it was necessary to store water sufficient to give about 100,000 h.p. for ten or twelve hours a day during about nine months of the year.

Three lakes are formed by four masonry dams, ranging from nearly ¾ mile long and 34½ ft. high to nearly 1½ miles long and 96 ft. high. Two of these form a "monsoon" lake of sufficient capacity to provide power during the longest "breaks" in the monsoon, and thus give an uninterrupted supply of power for three months and more. The other lakes are for storage, and maintain the power during the eight or nine months in the year when no rain falls.

The monsoon rain on the Western Ghats, though always heavy, is very variable in amount. The least annual amount during the last forty-eight years was 82 in. on the edge of the Deccan plain, and the greatest amount during the past eleven years, in which special gauges have been fixed, on hilltops as well as in plains, is 546 in., which fell in a little more than three months, 460 in. falling in about two months. The minimum fall of 82 in. is very exceptional, and the maximum given may be equally so. The combined available capacities of the two storage lakes is about 10,100,000,000 cubic ft., whilst the water required to give 100,000 h.p. ex turbines for nine months, allowing for the great loss by evaporation and by soakage and for friction in the pipes and turbines, is 6,700,000,000 cubic ft. The excess capacity is given owing to the very variable amounts of the monsoon rains, so as to carry on the balances in years of excessive rainfall to make up for the occasional short monsoons. It was arrived at by assuming the works had been completed forty years ago, there being one rain-gauge record covering that period—which includes four minimum years' fall—and deducting from each year's supply the amount which would have been used, lost by evaporation, run to waste, or carried on to the next year, which gives the excess capacity required for a sufficient number of years.

The amount of 546 in. measured at one hill station in the lakes catchment is not more than has been measured in two or three out of the past fifty odd years at Cherrapunji, in the Assam Hills, which has the heaviest rainfall hitherto known; but there rain falls during seven months of the year, so that the amount measured for this work for that particular year may claim to be the heaviest rainfall ever yet measured.

The works are notable for the following reasons:—They are the largest of the many similar hydro-electric works which have been constructed during the past ten or twenty years, taking into consideration the great head used, combined with the large discharge of water. The first is equal to about five times the height of St. Paul's Cross, and the latter is greater than the summer flow of the River Thames during five months. They are also the first works to store water for power for use during about three-fourths of the year. One of the masonry dams, taking the exposed face area, is probably the largest yet constructed. The works are probably unique, considering the very heavy rainfall and the very steep rocky slopes, giving the greatest discharge perhaps ever recorded. The catchment area of the two lakes is only 16½ square miles, while of this the full lakes area is about 7½ square miles.

The water is led from the monsoon lake and from

[1] Abstract of a paper on "The Tata Hydro-electric Power-supply Works, Bombay," by Mr. R. B. Joyner, read at the Institution of Civil Engineers on November 19

the two storage lakes, which are joined together by a tunnel a mile long, by two ducts, together 4·63 miles long, to the forebay at the top of the great precipitous scarp which forms the western boundary of the Deccan plateau. From there the two lines of steel pipes are taken down the steep slopes and precipices to the power-house, about 1750 ft. below the forebay, the length of single line being about 2·33 miles. The pipes at the top are 82½ in. in internal diameter, and at about two-thirds of the total height down the diameter is 72 in. Here they are joined by a double swan-neck pipe, from which eight smaller pipes are led down to the power-house, their diameter being 3½ ft. at the top, and 3 ft. 2 in. at the bottom. The thickness of the metal at the top of the large pipes is ⅜ in., and at the bottom of the small pipes 1¼ in.

Each of the lower smaller eight pipes supplies a Pelton-wheel turbine, designed to give a maximum of 13,500 h.p. with automatic regulation devices.

The works described are the first to be undertaken of a number of similar works proposed by the author, he having shown that it is financially possible in India to store water for use during eight or nine months of the year, and give power at a much cheaper cost than by the use of coal, oil, or spirit from vegetable products; likewise cheaper than power from the wind, sun, or tides. Not only that, but the water after use is available for irrigation, so valuable in a country without a drop of rain for a large part of the year. This would ensure the growth of the raw materials required for finished products on which the country is now so dependent upon other countries. It would also supply the factory workers or others with food and drink, and help to prevent famines, besides doing much to regularise the rainfall. Such power will provide electric traction for raw materials to, and finished products from, the factories, as well as light for them and neighbouring towns, produce fertilisers, and give the great heat required for the smelting of ores. Many industries would then be self-contained, and India could compete with Europe, America, or Japan for its finished products, and would become less dependent upon its agriculture, which the varying seasons render somewhat capricious.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—The University, which as yet has no professor of geography and only one lecturer on the subject, as compared with three professors and five lecturers in branches of history, has recently so far recognised its growing importance as to institute a diploma in geography, based on regulations involving a thorough and far-reaching study of certain aspects of geographical science. The diploma is intended for graduates in arts or science prepared to devote an additional *annus academicus* to the subject, and capable of passing an examination of somewhat high standard. The limited number of courses in pure geography available in the University under present conditions has made it necessary to have recourse extensively to other departments, and the aim of the regulations appears to be to induce students to specialise either in historical and economic geography or, but less markedly, in mathematical geography. A special feature is the stress laid upon economic ethnography, defined as the study of the influence of geographical environment on the life of the most important peoples. The regulations give much less scope to graduates whose tastes lie in the direction of physical geography in the wide sense, and, in view of the contributions which Scotland has made to oceanography and meteorology, it is remarkable that neither of these subjects finds a place in the list. Further, geology, which, especially in its physical aspects, has always had so many adherents in Scotland, is represented only by one optional course, and, like general geography, does not appear among the subjects of the diploma examination; nor does any branch of biology find a place there. Should it be found possible later to enlarge the department by the addition of new lecturers, the present diploma might fittingly become one in economic geography.

THE Aitchison memorial scholarship, founded in memory of the late Mr. James Aitchison, and tenable at the Northampton Polytechnic Institute for two years, 1918–20, has been awarded to Mr. V. C. Milligen, Goodmayes, Essex.

WE learn from the *Times* that the council of Clifton College has just received the sum of 1000*l.* from an old Cliftonian, Mr. W. J. Leonard, for the establishment of a leaving scholarship to Oxford and Cambridge in chemistry, physics, or biology, in memory of the mastership at Clifton of Mr. T. W. Dunn, assistant master and house master at Clifton from 1868 to 1878. While the scholarship is to be given to enable boys of good promise to pursue the study of natural science at the old Universities, it is only to be awarded to a candidate who has been in the sixth, or at least the fifth, form on the classical side.

THE Labour Party at its meeting on November 14 at the Royal Albert Hall to open the election campaign of the party adopted the programme drawn up by its executive committee. Of the twenty demands contained in the manifesto one deals with education, and runs as follows:—"A national system of education, free and effectively open to all persons, irrespective of their means, from the nursery school to the university; based on the principle of extending to persons of all ages, without distinction of class or wealth and without any taint of militarism, genuine opportunities for the most effective education on a broad and liberal basis, and the provision for teachers of all kinds and grades of salaries, pensions, training, and opportunities of advancement commensurate with the high social importance of their calling." No exception can be taken to the reasonableness of the ideals inspiring this statement, but it must be borne in mind frankly that not every boy and girl can benefit from a course of higher education, and that all that it is wise to insist upon is that every child shall have the opportunity of developing his intellectual powers to their fullest extent, and that social distinctions shall not be a bar to merited educational advancement.

A REPORT on the work of the Manchester Municipal College of Technology for the years 1913 to 1918 has just been published. The issue of annual reports was interrupted in 1914. The college has made its principal contribution to the task of winning the war by supplying the Army and Navy with men whose character and intelligence owe a great deal to their university training. It has supplied to the Royal Engineers, as well as to the technical branches of the Navy, Army, and Air Force, men whose training as engineers, chemists, or other technologists has enabled them to render effective service. In addition to supplying men, the college has undertaken war-work of different kinds. So great, indeed, have these new activities been that, despite the large reduction in the number of students, more research work has been done in the college during the past four years than in any other equal period of its history. The buildings and equipment have been improved in various ways during the period under review. In the summer of 1916 five new research rooms were equipped. Of these the most important is the new coal-tar products and dyestuffs research laboratory, furnished with a specially constructed electrically heated oven for giving variable and positive degrees of temperature. The increase in the expenditure of the college has been partly met by larger Government grants. In the year 1910–11 the grant received amounted to 11,895*l.*, while that received during 1915–16 was 16,646*l.*, including a special war grant of 1250*l.* Since 1902 commercial tests and investigations which could not be carried out elsewhere in or near Manchester have been undertaken by the college. The financial value of this work in 1914 was 398*l.* 14*s.* 6*d.*, whereas in 1917 it reached 2946*l.* 6*s.* 6*d.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 14.—Sir J. J. Thomson, president, in the chair.—A. **Mallock**: Sounds produced by drops falling on water.—G. H. **Hardy** and S. **Ramanujan**: The coefficients in the expansions of certain modular functions.—The Hon. R. J. **Strutt**: The light scattered by gases: its polarisation and intensity.—Dr. F. **Horton** and Ann C. **Davies**: An investigation of the ionising power of the positive ions from a glowing tantalum filament in helium. The ionising power of the positive ions from a glowing tantalum filament in helium has been investigated by a modification of the method due to Lenard. The positive ions were accelerated through a piece of platinum gauze into the ionisation chamber, and were there retarded by an opposing potential difference between the gauze and a movable collecting electrode, this retarding potential being constant during a series of experiments, and always greater than the greatest accelerating potential used in that series, so that none of the positive ions reached the collecting electrode. It was found that an increasing current was obtained in the ionisation chamber (the electrode collecting a negative charge) when the potential difference accelerating the positive ions was gradually raised above 20 volts. This result is similar to that obtained by Pawlow, and by Bahr and Franck, who concluded that helium atoms are ionised by the collisions of positive ions moving with 20 volts velocity. The experiments described in the paper have shown that the observed increasing current, with increasing accelerating potentials above, about 20 volts, is mainly due to the positive ions liberating electrons from the walls of the ionisation chamber which they bombard, and that the positive ions do not ionise the helium atoms even when they collide with velocities up to 200 volts.

Physical Society, October 25.—Prof. C. H. Lees, president, in the chair.—Discussion on the case for the ring electron. Dr. H. S. **Allen** discussed the arguments in favour of an electron in the form of a current circuit capable of producing magnetic effects. Then the electron, in addition to exerting electrostatic forces, behaves like a small magnet. The assumption of the ring electron removes many outstanding difficulties:—(1) There is no loss of energy by radiation as in the case of a classical electron circulating in an orbit. (2) Diamagnetic atoms must have a zero resultant magnetic moment. This is difficult to account for with electrons in orbital motion. (3) The ring electron gives a good explanation of the facts of paramagnetism, including the experimental results of K. T. Compton and Trousdale, and of A. H. Compton and O. Rognley obtained by X-ray analysis. (4) The asymmetry of certain types of radiation can be accounted for (A. H. Compton). (5) The effect of the magnetisation of iron upon its absorption coefficient for X-rays observed by Forman is explained. (6) The small amount of ionisation of gases produced by X-rays may receive an explanation. (7) Grondahl claims to have found evidence for a magnetic electron in certain thermo-electric effects. (8) Webster has given a method of deducing Planck's radiation formula by making certain assumptions as to the internal mechanism of Parson's "magneton." (9) It is suggested that Bohr's theory as to the origin of series lines in spectra may be restated so as to apply it to the ring electron. The essential points of the quantum theory and Bohr's equations may be retained, even if his atomic model be rejected. (10) If radiation is due to pulsations in a ring electron, the Zeeman effect may be deduced by reasoning similar to that first employed by Lorentz. (11) The scattering of streams of electrons from the sun due to electrostatic forces would be to some extent diminished. (12) Parson has shown that many of the problems of chemical constitution and stereochemistry may be solved by a magneton theory of the structure of the atom. *Stationary* valence electrons are possible. (13) The forces of cohesion in a solid are similar in nature to chemical forces, both sets of forces having an electromagnetic origin. The questions of the mass and magnetic moment of such a ring electron were discussed. It was pointed out that the adoption of this hypothesis would lead naturally to the acceptance of an atomic model with a magnetic core, as previously suggested by the speaker.

Mineralogical Society, November 5.—Sir William P. Beale, Bart., president, in the chair.—Dr. G. F. Herbert **Smith** and Dr. G. T. **Prior**: A plagionite-like mineral from Dumfriesshire. Specimens of antimony-lead ore collected by Lieut. Russell from Glendinning Mine contained small cavities lined with tiny black crystals, measuring less than 0·4 mm., and mostly less than 0·2 mm., across. Some resembled in habit the crystals of plagionite from the Hartz Mountains described by Lüdecke. Measurements made on the three-circle goniometer showed the crystals to belong to the semseyite end of the group, and the result of a chemical analysis of the compact material of which the crystals form part corresponded approximately with the formula $5PbS.2Sb_2S_3$. Semseyite has not previously been recorded from the British Isles.—Lieut. A. **Russell**: The chromite deposits in the Island of Unst, Shetlands. The bottle-shaped mass of serpentine which runs through the centre of the island from north to south contains chromite uniformly distributed, but varying greatly in character, being at times massive, but generally granular. More than thirty quarries are known, but only six of them have been worked to any extent. The associated minerals include kämmererite (abundant in one quarry), uvarovite, copper, hibbertite, brucite, calcite, talc, and magnetite. The rocks other than the serpentine are poor in minerals.—Dr. G. T. **Prior**: The nickeliferous iron of the meteorites of Bluff, Chandakapur, Château Renard, Cynthiana, Dhurmsala, Eli Elwah, Gnadenfrei, Kakowa, Lundsgård, New Concord, Shelburne, and Shytal. The percentage of nickeliferous iron and the ratio of iron to nickel in the several instances were found to be respectively 5, 6½; 8, 9; 8½, 6½; 6, 6; 3½, 3½; 6½, 7½; 21½, 12½; 8, 6; 8½, 7; 10, 8; 10½, 10; 7½, 6½.

Zoological Society, November 5.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. J. F. **Gemmill**: The cause of the ciliary action in the internal cavities of the Ctenophore (*Pleurobrachia pileus*).—Dr. R. T. **Leiper**: Diagnosis of helminth infections from the character of the eggs in the fæces. Dr. Leiper stated that, by examination of the fæces of a living animal, the extent and specific nature of most helminthic infections could be accurately determined, and the method had been applied successfully as a routine practice in the case of man, rabbit, dog, cat, and pig, and was apparently capable of indefinite extension. The eggs of parasitic worms were constant in character and of great systematic importance. The ground-plan of the eggshell indicated the genus, or even subfamily, to which the parasite belonged, and specific differences were found in slight but constant peculiarities in relative length and breadth, and in the conformation of excrescences on the surface of the shell.—Dr. R. T. **Leiper**: The "new" rabbit disease. Examination of a large number of rabbits shows that the chief cause of mortality is a coccidial invasion of the intestinal wall or of the lining of the bile-ducts. According to Fantham and others, the causal agent in both types of disease is *Eimeria stiedae*, but Dobell holds that the intestinal lesion is due to a distinct species. In many cases changes in the liver attributed to coccidiosis were the result of infection with *Cysticercus pisiformis*, the larval stage of the dog tapeworm (*Taenia serrata*). Large swellings in the region of the head and neck, suspected to be cancerous, were due to *Coenusus serialis*, the larva of the dog tapeworm *Taenia coenurus*. Of relatively small economic importance are infections with the threadworm (*Oxyuris ambiguus*) and the tapeworm (*Ctenotaenia leuckarti*). There is some evidence that a bacterial infection may occasionally be the cause of death. The coccidial infections pass from infected to healthy animals through the fæces. When freshly passed, the coccidial oocysts are not infective. They only become so after a period of delay, in which certain developmental changes take place. These changes proceed more rapidly in dry than in wet fæces. Prevention depends upon the systematic periodical removal and destruction by burning of all pellets and contaminated bedding, and the use of some fluid which will destroy such oocysts as remain in the hutch. Although several cases of coccidial infection in man have been recorded, Dobell maintains that in none of these cases is *Eimeria stiedae* the causal agent. There would appear, therefore, to be no risk of infection to man. The cystic stages of the tapeworms of the dog appear to occur chiefly in those rabbits fed with dandelions and other greenstuffs collected from the roadsides, where the vegetation is especially liable to contamination with fæces of dogs which have acquired their infections from eating uncooked rabbit offal.

Linnean Society, November 7.—Sir David Prain, president, in the chair.—The late Dr. E. A. Newell **Arber** and F. W. **Lawfield**: The external morphology of the stems of Calamites, with a revision of the British species of Calamophloios and Dictyocalamites of Upper Carboniferous age. This paper dealt with the external morphology of Calamites and their reception into the new form genus—Calamophloios—previously erected by Dr. Arber. No systematic endeavour to differentiate specimens showing the external surfaces of Calamites has previously been made, although the attempt was long overdue. By further inquiry it was hoped to correlate the various species of Calamophloios with those species restricted to pith-casts, and a beginning had already been made in this paper.—Mrs. **Arber**: The "law of loss" in evolution. It appears to be a general rule that a structure or organ once lost in the course of phylogeny can never be regained; if the organism afterwards has occasion to replace it, it cannot be reproduced, but must be constructed afresh in some different mode. The author proposes to term this principle the "law of loss." This law is obviously not susceptible of direct proof, but an attempt is made to show that, if used as a working hypothesis, it throws light on a number of structural features the interpretation of which presents difficulties on other theories. Some time after the author had deduced the "law of loss" from a comparative study of living plants, she learned that zoologists had already arrived at very similar conclusions regarding vertebrates from a study of their palæontological history. Dollo's "law of irreversibility" covers much the same ground as the "law of loss." The fact that the same principle has been recognised independently for plants and for animals—in one case through a study of comparative morphology, and in the other through a consideration of actual historical evidence derived from fossil records—seems to be an indication of the validity of the law.

Mathematical Society, November 14.—Annual meeting. —Prof. H. M. Macdonald (retiring president) and afterwards Mr. J. E. Campbell (new president) in the chair.—Prof. H. M. **Macdonald** (retiring president): Presidential address.—Prof. M. J. M. **Hill**: The use of a property of Jacobians to determine the character of any solution of an ordinary differential equation of the first order, or of a linear partial differential equation of the first order.—Prof. H. J. **Priestley**: The roots of a certain equation in spherical harmonics.—J. **Hodgkinson**: A detail in conformal representation.—T. A. **Broderick**: The product of semiconvergent series.—Dr. W. P. **Milne**: A simple condition for co-apolar triangles.

EDINBURGH.

Royal Society, October 28.—Dr. Horne, president, in the chair.—The president delivered an opening address on the endowment of scientific and industrial research.—Dr. T. S. **Patterson** and Mr. K. L. **Moudgill**: Researches in optical activity: the temperature rotation curves for the tartrates at low temperatures. By the piecing together of evidence of different kinds, general temperature-rotation curves for the tartrates have been arrived at. These graphs show maxima and minima, and also a region of intersection. The influence of temperature changes, of change of solvent, of change of concentration, or of change of constitution appears to be to displace the whole series of graphs in one direction or the other, with, of course, accompanying minor alterations. The present paper describes the investigation of the temperature-rotation curves for tartrates at the low temperature end of the diagram, where a deep minimum is shown to exist.—Miss M. G. **Haseman**: Amphicheiral knots. This is a continuation of a former communication on amphicheiral knots, and contains, among other things, the description of two amphicheiral knots of twelve intersections which had formerly escaped notice.—Dr. C. G. **Knott**: Further note on the propagation of earthquake waves. Following up the investigations given in a former paper (see NATURE, February 21, 1918), the author directed attention to the curious sinuous form of seismic rays which emerge at an arcual distance of from 60°–80° from the epicentre, and reach a depth of about a quarter of the earth's radius. This sinuosity proves that in the neighbourhood of that depth the velocity of propagation, after increasing with the depth, begins to diminish, but this diminution does not seem to continue to greater depths.

MANCHESTER.

Literary and Philosophical Society, October 29.—Mr. W. Thomson, president, in the chair.—Prof. C. A. **Edwards**: The hardness of metals. Prof. Edwards gave an account of various methods of making hardness determinations, and described a new apparatus which was designed for making hardness tests at high temperatures. He also gave data showing that the hardness of pure solid elements is a periodic function of their atomic weight.

SYDNEY.

Royal Society of New South Wales, September 4.—Mr. W. S. Dun, president, in the chair.—W. G. **Woolnough**: The Darling peneplain of Western Australia. The physiographic feature in Western Australia called by Jutson the Darling peneplain repeats in many respects the characters of the Blue Mountain uplands of New South Wales. It extends as a monotonous, laterite-covered plateau from the steep escarpment twelve miles east of Perth for nearly four hundred miles through the eastern goldfields. The monotony of the surface is interrupted by occasional hills representing residuals of a pre-existing plateau from which the Darling peneplain has been eroded, and by long, shallow valleys, forming the great wheat-belt of the State, which have been carved out of its surface by rivers.—Prof. C. E. **Fawsitt** and A. A. **Pain**: Experiments on the behaviour of iron in contact with sulphuric acid. The very slow action of concentrated sulphuric acid on steel is only accelerated to a moderate extent by dilution with several per cent. of water. For instance, 85 per cent. of acid has only a very slightly greater action than 94 per cent. of acid. The rate of action increases rather suddenly when diluting from 85 per cent. to 80 per cent. of acid, and again from 70 per cent. to 65 per cent. of acid. The electrical potential of iron with respect to concentrated sulphuric acid falls noticeably after the iron has been lying in the acid for a few minutes. The original potential is largely restored by exposing the iron for a few minutes to the air.—H. G. **Smith**: The resinous earth occurring at the head of the Nambucca River, N.S.W. This paper records the results of an investigation of the earth from two localities. It is shown that the ready ignition is due to the presence of the resin the earth contains. That it is of organic origin is indicated from the results of the analysis. The presence of nitrogenous products, as well as of phosphoric acid and a small amount of benzoic acid, also supports the conclusion.

BOOKS RECEIVED.

A Manual of Chemistry. Theoretical and Practical. Inorganic and Organic. By Dr. A. P. Luff and H. C. H. Candy. Sixth edition. Pp. xix+745. (London: Cassell and Co., Ltd.) 12*s.* net.

Petrol and Petroleum Spirits: A Description of their Sources, Preparation, Examination, and Uses. By Capt. W. E. Guttentag. Pp. xi+135. (London: E. Arnold.) 10*s.* 6*d.* net.

Surgery at a Casualty Clearing Station. By C. Wallace and J. Fraser. Pp. xi+320. (London: A. and C. Black, Ltd.) 10*s.* 6*d.* net.

Folk-lore in the Old Testament: Studies in Comparative Religion, Legend, and Law. By Sir J. G. Frazer. 3 vols. Vol. i., pp. xxv+569; vol. ii., pp. xvi+571; vol. iii., pp. xviii+566. (London: Macmillan and Co., Ltd.) 37*s.* 6*d.* net.

Civic Biology. By Prof. C. F. Hodge and Dr. J. Dawson. Pp. viii+381, with plates. (London: Ginn and Co.) 7*s.* net.

Projective Geometry. By Profs. O. Veblen and J. W. Young. Vol. ii. Pp. xii+511. (London: Ginn and Co.) 21*s.* net.

Industrial Electrical Measuring Instruments. By K. Edgcumbe. Second edition. Pp. xvi+414. (London: Constable and Co., Ltd.) 16*s.* net.

Junior Grade Science. By G. A. Watson. Pp. ix+181. (London: Macmillan and Co., Ltd.) 3*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—W. Stiles and Dr. F. Kidd: (1) The Influence of External Concentration on the Position of the Equilibrium attained in the Intake of Salts by Plant Cells; (2) The Comparative Rate of Absorption of various Salts by Plant Tissue.—G. Marinesco: Recherches Anatomo-Cliniques sur les Névromes d'Amputations douloureux: Nouvelles Contributions à l'Etude de la Régénération nerveuse et du Neurotropisme.

LINNEAN SOCIETY, at 5.—E. S. Goodrich: A Fatherless Frog, with remarks on Artificial Parthenogenesis.—Miss Muriel Bristol: A Review of the Genus Chlorochytrium, Cohn.—A. S. Kennard and B. B. Woodward: The Linnean Species of Non-marine Mollusca that are represented in the British Fauna, with Notes on the Specimens of these and other British Forms in the Linnean Collection.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Everard im Thurn: The Present State of the Pacific Islands.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—R. R. Kahan: Refining Gold Bullion with Chlorine Gas and Air.—A. Yates: Effect of Heating and Heating and Quenching Cornish Tin Ores before Crushing.—R. J. Harvey: The Development of Galena Flotation at the Central Mine, Broken Hill.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. H. Shaw: The Use of High Pressure and High Temperature Steam in Large Power Stations.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

MONDAY, NOVEMBER 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Arnold Hodson: Southern Abyssinia.

TUESDAY, NOVEMBER 26.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—F. G. Parsons: Anthropological Observations on German Prisoners of War.

WEDNESDAY, NOVEMBER 27.

ROYAL SOCIETY OF ARTS, at 4.30.—Lord D'Abernon: Drink Control in Various Countries.

THURSDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 4.30.—Bhupendranath Basu: Some Aspects of Hindu Life.

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

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THURSDAY, NOVEMBER 28, 1918.

ABSORPTION SPECTRA AND CHEMICAL CONSTITUTION.

Colour in Relation to Chemical Constitution. By Prof. E. R. Watson. Pp. xii+197. (London: Longmans, Green, and Co., 1918.) Price 12*s.* 6*d.* net.

IT is justifiable to ask whether this book has been written to help those engaged in research on synthetic dyestuffs or as a text-book for those investigating the problems of absorption spectra. On one hand it contains scarcely anything of sufficient definiteness for the colour chemist to pin his faith to, and, on the other, the information is not complete enough to justify its use as a text-book on absorption spectra. The author, however, can scarcely be blamed for the lack of definiteness in establishing even one article of faith for the colour chemist to accept, because it is progressively becoming more evident that there is no definite relation between colour and chemical constitution in the generally accepted sense. Every one of the theories connecting the two that from time to time have been proposed is shown by the author to fail in one way or another. Even his own theory of oscillation within a conjugated system of double bonds is of limited application, for it entirely fails to explain his own test case of the blue nitroso-derivatives of the paraffins, not to mention the numerous examples of colour changes shown by the same compound in different solvents. The time has surely come when it were wiser frankly to let the colour chemist into the secret and tell him that the usual conception of correlation between colour and constitution has been found to be unsound. Let us be brave and state that the real connection between them is far deeper than any of the theories of Witt, Nietzki, Armstrong, von Baeyer, or Hantzsch would lead us to believe.

Criticism must be made of some statements in this book, statements which cannot be allowed to pass unchallenged. For example, Beer's law cannot be said to be true within a wide range. The substances which conform to this law are relatively few, and, indeed, the law is more honoured in the breach than in the observance. Then, again, it would seem that the author has confused the number of absorption bands shown by substances. Many absorption bands exhibit a number of sub-groups, and great care must be taken to guard against looking upon these sub-groups as separate absorption bands. Some of the author's criticisms are based on this error and lose their point when it is remembered that different sub-groups of one band and not different absorption bands are under discussion.

Then, again, the persistence of a band is wrongly defined as the ordinate passing through the head of an absorption band; this ordinate is, of course, a measure of the absorptive power, while the persistence is the difference between the extreme ordinates over which the band persists. Although this is a minor point, it directs attention to the fact mentioned by the author of the remarkable differences shown by substances in the persistence of their absorption bands. The reason for this is that in the case of those compounds which exhibit relatively shallow bands very few molecules exist in the absorbing condition, the remainder not exerting any selective absorption in the spectral region under examination. It will at once be seen how dangerous it becomes to dogmatise or even postulate any theory as to the constitutional origin of a band when such is due to a very small fraction of the molecules present.

The book is well put together and excellently illustrated with absorption curves of a variety of compounds. The chapters dealing with the earlier theories on colour and constitution are well written, and although the discussion of each of these is necessarily restricted, the author has succeeded in presenting their salient points well. Chapters are devoted to infra-red absorption and to fluorescence, and finally there is a good account of the work on the colour of inorganic compounds. In some ways this book may be recommended, but the impression will remain that the author loses conviction by reason of having stepped too delicately.

E. C. C. B.

SYNTHETIC AND ANALYTIC PHYSICS.

(1) *Cours de Physique Générale.* By H. Ollivier. Tome Troisième. Pp. 632. (Paris: A. Hermann et Fils, 1918.) Price 30 francs.

(2) *Electrical Experiments.* By A. Risdon Palmer. Pp. xii+115. (London: Thomas Murby and Co., 1918.) Price 1*s.* 6*d.* net.

(3) *Magnetic Measurements and Experiments (with Answers).* By A. Risdon Palmer. Pp. 124. (London: Thomas Murby and Co., 1918.) Price 1*s.* 6*d.* net.

IN the discussion on the teaching of physics in schools which took place recently at a meeting of the Physical Society two methods of teaching physics were contrasted. The first, which may be called the synthetic method, starts from certain general principles and develops the consequences of those principles. The second, or analytic method, dissects out the principles from some more or less complicated piece of mechanism. Thus the first method starts with Boyle's law and ends with the steam-engine, whilst in the second method the order is reversed. Each method has its advantages and its drawbacks, and makes its appeal to a particular type of mind or at a particular stage of development. The volumes under discussion may be regarded as examples of the two methods of presentation.

(1) The subject of vibrations and their transmission forms the groundwork of the third part of M. Ollivier's text-book, and it is developed from first principles with the lucidity which seems to be innate in French scientific writers. The first six chapters may be regarded as introductory; they contain a concise and interesting summary of the main features of periodic functions, of

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vibratory movements, and of wave motion. Chap. vii. deals briefly with the subject of acoustics, and includes a detailed description of the anatomy of the ear, with excellent diagrams after A. Pizon. Then follows a lengthy section devoted to physical optics, in which the subjects of interference, diffraction, and polarisation are discussed in a masterly manner, one of the valuable features of this portion of the work being the number of problems worked out in detail with numerical illustrations. In dealing with the passage of polarised light through crystalline plates extensive use is made of the geometrical construction devised by Poincaré, in which the characteristics of the elliptically polarised light are represented by the position of a point on the surface of a sphere.

The damped oscillations of certain material systems, such as moving-coil galvanometers, are considered in chap. xv. At first sight the chapter on thermionic apparatus seems somewhat out of place, but this impression is removed when it is realised how important a part thermionic valves and amplifiers play in connection with electric oscillations and wireless telegraphy and telephony. Recent improvements in these departments of applied electricity are described in most interesting fashion. The remaining chapters deal with electro-optics and optical effects due to motion, the volume closing with a brief review of the principle of relativity.

Special interest attaches to this volume through the circumstances in which it has been produced. In an introductory statement M. Ollivier says: "Ce n'est pas sans une profonde émotion que nous publions ces leçons professées à Lille avant la guerre. Car aux souvenirs heureux qu'elles évoquent pour nous, au rappel d'un temps où notre Université était grande et florissante, s'ajoute en un contraste déchirant la longue et cruelle vision des malheurs qui sont venus. Ce n'est pas à nous qu'il appartient de décrire les souffrances infinies de la ville martyrisée. Mais nous ne voulons pas signer ce livre sans adresser un hommage à nos collègues et à nos élèves morts."

(2 and 3) Two useful books for beginners are provided by Mr. Risdon Palmer, who is familiar with the difficulties of both student and teacher. In the study of electricity the analytic method is employed. The first experiments to be performed involve the use of accumulators, glow-lamps, adjustable resistances, voltmeters and ammeters. Even if the treatment is not strictly logical, the student at once acquires some familiarity with the notions of electromotive force, resistance, and current. In magnetism the idea of pole strength is based on the use of a simple form of magnetic balance, and the experiments are supplemented by illustrative examples and arithmetical questions. Considerable emphasis is rightly laid on the expression of results in the appropriate units, the realisation of the magnitude of the quantities involved, and graphical representations.

H. S. ALLEN.

PRACTICAL FORESTRY.

Forestry Work. By W. H. Whellens. Pp. 236. (London: T. Fisher Unwin, Ltd., 1918.) Price 8*s*. 6*d*. net.

THE author of this book is a working forester, who has had much experience while in charge of large wooded estates in England and Scotland. He tries to explain in simple language the actual operations which are usually carried out on such estates, and in this is fairly successful. The book can be recommended as a useful one for the forestry apprentice, and will be found serviceable in giving instruction to disbanded soldiers and to women who are now taking short courses in nursery work, measuring timber, etc., at various centres. There is nothing novel in the book, which is simply a straightforward account of ordinary British forestry practice. Whether this practice requires amendment or improvement is another matter. Hitherto, on private woodland estates, methods have been in vogue which are not strictly economical. In the future money will be scarce, and efforts must be made either to invent cheaper methods or to import such from foreign countries, like the United States, where of late ingenious inventions have been devised, which save labour materially in the planting and in the felling of trees.

Mr. Whellens's first chapter deals mainly with nursery work, and contains much that is valuable and well put; but no mention is made of the transplanting lath or of the method employed at Brocklesby and Abbeyleix, by which young trees are ploughed out of the nursery lines instead of being lifted; yet these are excellent labour-saving devices. The chapter on the preparation of the ground for planting, on draining, and on fencing is well done. Sowing and planting are next dealt with. The chapter on tending plantations is unsatisfactory, the difficult subject of thinning being too briefly treated, while much space is given to pruning, an unnecessary and expensive operation in most cases. Felling timber is rather summarily disposed of, and nothing is said about clearing the area after felling. The space devoted to the measurement of timber is quite inadequate, and requires considerable enlargement to make the subject intelligible to workmen. The chapter on insect and fungoid enemies is without illustrations, and the descriptions are too short. The appendix is a collection of useful tables.

DEVELOPMENTS OF THE THEORY OF RELATIVITY.

The Theory of the Relativity of Motion. By R. C. Tolman. Pp. ix+225. (Berkeley: University of California Press, 1917.)

THE author of this book takes much for granted. The main source of interest in the principle of relativity is the revolution which it demands in the concepts of space and time. It is not easy for most people to accommodate themselves to the changes which they are asked to make in these fundamental elements of their thought. But until this has been done the postulate "that the velocity of light in free space appears the same to all observers regardless of the relative motion of the source and the observer" is one that remains a stumbling-block, and the detailed mathematical discussion of the consequences of such a postulate must remain a matter of minor interest.

In the development of any branch of scientific thought it generally happens that in the form finally assumed the historic order of thought is reversed. The process of analysis of the complex into its constituent elements is replaced by a formal synthesis of those elements to reproduce the original complex. To the student seeking to get a living grasp of the meaning of science, and not a mere formal and abstract parallel to it, it is necessary to go through in his own experience the stages by which the perfected final form of the science has been reached. The teacher and the writer of text-books should therefore seek first of all to give the benefit of his knowledge and matured thought to enable the reader to pass painlessly and naturally through those various phases. When this has been done, the demonstration of unforeseen consequences is legitimate.

The present author places quite late in the book those transformation equations for the electric and magnetic intensities which played an absolutely vital part in making the enunciation of the principle possible. One may be permitted to wonder if in so doing he is not writing with his eye too close to his subject, so that the reader does not come sufficiently into his field of view.

But, this being a matter of common occurrence, it may pass, and the book may be recommended as an account of the later developments of the theory of relativity, which dwell particularly on those quantities which seem to have a significance that is not relative. In particular the "action" of a dynamical system is one that has some such absolute meaning if it be true that the motion of a system is to satisfy the principle of least action regardless of the velocity which the observer chooses to assign to himself. The invariance of the action seems to be the most comprehensive summing up of the consequences of the principle of relativity, and at the same time opens out the possibility of the generalisation of it in the way that Einstein has recently achieved. This extension of the principle does not come within the scope of the book, which concludes with a presentation of the four-dimensional vector analysis in the form developed by Wilson and Lewis.

OUR BOOKSHELF.

Die Vegetation des Val Onsernone (Kanton Tessin). By J. Bär. 80 pp., with coloured phytogeographical map. (Zurich: Rascher and Co., 1918.) Price 3 francs.

THIS is a very compact description of the vegetation of a mountain valley-basin south of the Alps, a little to the north-west of Lago Maggiore. The rainfall is high (80 in. to 100 in.), and is nearly all received during the summer. At the same time, the number of rainy days is low and of clear days high, so that a great deal of sunshine is received, and the winter temperatures are relatively high. Thus we have a combination of some of the favourable conditions for vegetation characteristic of an "oceanic" climate with some of those characteristic of a continental one, a combination which, together with the great range of altitude (250 m. to 2500 m.) within the area, leads to the occurrence of a very wide range of vegetation and a very large number of species. The vastly greater proportion of the whole area of 113 sq. km. is covered with trees and shrubs. The general altitudinal forest zonation on the northern exposures is chestnut, beech, silver fir, spruce, and larch, with the addition of extensive birch woods and more local lime and grey alder woods according to the soil conditions. Besides these there are extensive scrub associations of hazel, chestnut, birch, beech, and oak, which play an important part in the economy of the valley as pasture for goats, besides unpastured scrub of willow, alpine alder, alpine rose, juniper, etc., "heaths" of heather, broom, and bilberry, and numerous types of grassland. Many of the associations are almost identical with common British types. Above these there is a wide selection of alpine types, and at the other end of the scale an association of the Mediterranean *Cistus salviifolius.* The memoir is accompanied by an excellent vegetation map, in which the distribution of the dominant trees and shrubs is depicted by means of coloured symbols.

Food Gardening: For Beginners and Experts. By H. Valentine Davis. Second edition, revised and enlarged. Pp. viii+133. (London: G. Bell and Sons, Ltd., 1918.) Price 1*s*. net.

THIS handbook will prove useful to the allotment-holder, as it sets forth clearly and fully the details of cultivation of the commoner vegetables. The first part of the book, however, contains several instructions that are misleading and may cause difficulty. It is contrary to all accepted usage to grow root crops and onions on soil which has not been dug or even forked over since the removal of the previous crop. The plan may succeed on light land, but on heavy, sticky soil such a procedure would probably court failure. For many districts June is very late for planting maincrop potatoes, and parsnip-sowing should not be deferred until April. It is also beside the mark to recommend that green peas should be eaten raw, and to suggest that discarded woollen garments and leather articles should be used for manurial purposes. On the other hand, the details of working are usually well explained, and the calendar of operations affords a useful guide to the approximate times for carrying out the more important pieces of work. The second part, dealing with such crops as tomatoes and celery, is very lucid, and the hints on the winter storing of vegetables and on the destruction of diseases and pests are valuable and practical.

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.]*

Zeiss Abbe Refractometer.

IN reply to Mr. Simeon's communication published in NATURE of November 21, we would state that of the many different types of Zeiss Abbe refractometer, including a late pre-war instrument, that have passed through our hands for repair, all have been fitted with an illuminating prism of low refractive index glass (N_D about 1·515). In every case, by substituting an extra dense prism of suitable angle, we have rendered the instrument serviceable for the examination of liquids above 1·52. We discovered this defect some time ago, and later directed the attention of Prof. Cheshire to it, communicating it to NATURE of June 21, 1917 (vol. xcix., p. 331). We have a number of these low-refractive index prisms which have been removed from Zeiss refractometers, and also a complete Zeiss instrument showing the defect mentioned. It would, perhaps, be possible to arrange to bring this instrument and the prisms to the next meeting of the Optical Society, and if Mr. Simeon would bring a Zeiss instrument having a pair of extra dense prisms, a comparison would be interesting. It is just possible that the Zeiss instrument to which Mr. Simeon refers is one in which a dense lower prism has been substituted.

As we have already pointed out, in theory any glass would make a suitable illuminating prism so long as the roughened surface remains unimpaired, but in practice the cleaning of the prism surface tends to polish it, and as a result the illumination quickly falls almost to vanishing-point. L. BELLINGHAM.

Bellingham and Stanley, Ltd.,
71 Hornsey Rise, N.19, November 22.

BRITISH IRON-ORE RESOURCES.

ONE of the most marked effects of the war has been the stimulus that it has given to the development of the mineral resources of the British Empire, and particularly of those of Great Britain. For many reasons the more active exploitation of our home iron ores has been one of the most prominent features of this movement. Up to the invention of the Bessemer process the iron industry of this country depended practically exclusively upon domestic ores, the bulk of the ores smelted being the claybands and blackbands of the Coal Measures; in addition to these the red hæmatites of the Mountain Limestone of the West Coast and some of the Jurassic ironstones were also worked, but up to about 1870 the iron-ore deposits of the Palæozoic rocks formed the mainstay of our British iron industry. When the Bessemer process introduced mild steel as an important factor in the industry, the relatively small production of West Coast hæmatite no longer sufficed for our needs, and as many of our centres of iron-smelting are situated within easy access of the coast, Bessemer ores were naturally looked for abroad, and an energetic importation of foreign ores ensued. Bilbao ore was first imported about 1870, and by 1878, after the Carlist War, this importation had reached 850,000 tons; in 1913 the importation from Spain, to which Almeria and other parts of Spain contributed as well as Bilbao, was 4½ million tons, whilst our total imports from abroad, by far the greater part of which was Bessemer ore, amounted to about 7½ million tons. The domestic ore production was 16 million tons, of which about 12 million tons came from the Jurassic ironstones. The growth in the output of these last-named ores was due in large measure to the increasing adoption of the basic process of steel-making. When the war rendered the importation of foreign ores difficult and expensive, our iron and steel industry had to rely more and more upon basic steel produced from the latter class of ore. This development has been favoured by the grudging recognition that for most purposes basic steel properly made is as good as acid, and furthermore by the abandonment by the Board of Agriculture of the so-called citric acid test for basic slag in favour of its valuation by the total phosphoric acid present; this means that whereas under the former "made in Germany" test thousands of tons of British basic slag had to be dumped out at sea as unsaleable, such slag can now be utilised and its phosphoric acid contents rendered available for the British agriculturist. At the same time, the British steel trade now has a market opened up for what was before a waste product.

One of the signs of the increasing interest taken in domestic ores is the attention that is being devoted to the study of our iron-ore resources. Apart from some earlier descriptions of British iron ores, which have to-day at most only an historical interest, the first attempt at a real estimate of our iron-ore resources was that published by the present writer in the important treatise issued by the Eleventh International Geological Congress at Stockholm in 1910. This showed for the first time the magnitude of Britain's iron-ore reserves, and attracted much attention on the Continent; it would be interesting to speculate how far it may have contributed towards Germany's intention to bring about the war, one of the main motives of which was Germany's desire to obtain possession of the French iron-ore fields and thus to outstrip all competition by commanding far the largest iron-ore supplies of Europe. The principal value of the above-named estimate to-day lies in the fact that it has formed the basis of newer and more accurate estimates. Since the beginning of the war three important contributions to our knowledge of our own iron-ore resources have appeared, each under the auspices of a Government department—it need scarcely be added, having regard to our characteristic British methods, a different department in each case, working independently of the others. Nothing could be more eloquent of the need for a central administration, co-ordinating such efforts and avoiding useless duplication of work. The first was the now well-known report on the resources and production of iron ores, etc., by Mr. G. C. Lloyd, issued by the Department of Scientific and Industrial Research, which appeared in May, 1917, a second, revised and enlarged edition being issued towards the end of the same year.

In the spring of this year an important paper was read by Dr. F. H. Hatch before the Iron and Steel Institute by permission of the Controller of Iron and Steel Production, Ministry of Munitions, the data for this having been collected by Dr. Hatch working for that Ministry. It deals with the Jurassic ironstones of the United Kingdom, and, as has already been shown, these constitute by far the most important of the British iron resources from the economic point of view. The deposits dealt with comprise the Northamptonshire, Cleveland, Leicestershire, Oxfordshire, Lincolnshire, and Raasay ironstones, and full descriptions are given of their geology, mode of occurrence, and chemical composition, the numerous tables of analyses being particularly valuable. Finally, Dr. A. Strahan, Director of the Geological Survey, has recently issued his annual report, in which he presents very interesting estimates of the quantity of iron ore that may fairly be assumed to exist in the various deposits. This is a summary of an extensive series of investigations upon British iron-ore deposits which the Geological Survey has been recently conducting, the detailed reports upon which are being awaited with much interest. It constitutes a portion of the very valuable "Special Reports on the Mineral Resources of Great Britain," the first volume of which was issued in November, 1915; in the introduction to this volume Dr. Strahan has set out clearly the object of these reports and their economic significance.

The present report summarises as follows the iron-ore resources of Great Britain under two heads: (*a*) reserves more or less developed, and (*b*) probable additional reserves. The figures are:—

	(*a*)	(*b*)
Hæmatites, etc. ...	42,500,000 tons	75,000,000 tons
Mesozoic ores ...	1,775,052,160 ,,	2,104,886,000 ,,
Clay-ironstones and blackbands ...	1,065,637,000 ,,	6,248,475,600 ,,

Dr. Strahan says that the estimates are "framed in a cautious spirit," and this statement may readily be accepted. Indeed, as regards the last class, the figures are palpably under-estimated; thus the probable additional reserves are given as about 6250 million tons, of which four-fifths are credited to South Wales and Monmouthshire, the coalfield which Dr. Strahan probably knows best. There is no reason to suppose that the other British coalfields fall so far short of South Wales in iron contents as collectively to contribute only one-fifth of the whole, and in some cases the figures are clearly wrong. For instance, for the whole of the great northern coalfield he gives only 1·5 million tons, apparently taking the Redesdale area alone, whilst Durham is not even mentioned. Yet such ironstones were worked extensively at Shotley Bridge and other places in the Derwent Valley, as well as at Waldridge Fell, Urpeth, Birtley, Tow Law, and other points in the county of Durham, whilst in Northumberland they were worked at Wylam and Lemington in the extreme south of the county, and at places so far apart as Haltwhistle, Hareshaw, Redesdale, and Brinkburn. There is no evidence whatever that the ironstone was worked out at any of these places, but quite the contrary, and there is at least a probability that it underlies the entire coalfield, though whether it will ever prove to be workable is another question; Dr. Strahan, however, points out that he is "concerned only with the quantities that exist," quite apart from their workability. It must indeed be admitted that this part of the question is one of scientific rather than of economic interest, and in any case the full reports are not yet available, though it is to be hoped that they soon will be. All contributions to our knowledge of our own mineral resources are of the greatest value to the nation at the present time.

H. LOUIS.

TROPICAL QUEENSLAND.[1]

THE author does well to remind us that much of Queensland is tropical, and that it possesses the largest barrier reef in the world, enclosing a lagoon of immense size and possibly of great potential wealth in pearls, pearl-shell, bêche-de-mer (trepang), fish, and perhaps some day sponges as well. Here, on Hinchinbrook, a coastal island made known to us by his "Confessions of a Beachcomber," the author ruminates on the birds, beasts, and plants around him, a true beachcomber far from and almost uninterested in the world's affairs, content to bask in the suns of his Arcady. All is delightful; the greatest men of the past are those born in the lands of the sun; the planter tills not, but "permits Nature to have her own wayward will with his dutiful trees"; "vegetation does not tolerate any period of rest," and here are "many lusty, fat, sleek, good-humoured, straight-backed, frolicsome calves." It is impossible to criticise from the point of view of science, since the author's writing partakes of the Arcadian nature of his pursuits. The power of observation of, and a feeling for, the important facts of life in all living Nature the author certainly has, but we have the uneasy feeling that he has set out to write a book, whereas in his "Confessions," he poured out his soul and gave us a book of permanent value. "Tropic Days" is, however, thoroughly pleasant chat, well fitted for one's lighter hours, and as such likely to appeal to a wide circle of readers.

Descriptions of trees and plants are always excellent, and a charming individuality is given to certain trees of the domain. A chapter on beach plants reveals in this environment practically the same types of growths and plants as are found in

[1] "Tropic Days." By E. J. Banfield. Pp. 313. (London: T. Fisher Unwin, Ltd., 1918.) Price 16s. net.

the most distant coral islands of the Indo-Pacific with but few additions from neighbouring continental shores. The same is true also of sea and shore birds, but neighbouring lands give many visitors, which quickly learn to eat what man cultivates. A photograph of a baby nightjar in dead leaves is excellent, and, indeed, requires its explanatory diagram to point out the bird. We like the idea of a conchological (not floral) almanac, for we have ourselves noticed in the tropics the regularity of the approach to the shores, the coming up from the deep, of many Trochi, etc., almost as regular as the "balolo" worm obeys the call of an especial phase of the moon at the same season of every year. In "Snake and Frog Prattle" the author as naturalist is at his best. His true character as a man is perhaps shown in "Time's Finger," a simple, eloquent account of a solitary climb into the "debil-debil" land where his "boy" dare not come; it is a story of adventure in which the author nearly lost his life, and it gives also a remarkable picture of how tropical jungle manages to conquer even perpendicular granite slopes. The domination of multi-rooted trees, banyans (fig trees), mangroves, and screwpines (Pandani) is typical of tropical moist jungles. For the ethnologist there are a few stories of natives, and we particularly commend to those who dwell at home the psychology of "Cassowary" and "Soosie" as typical, the produce "of the very land on which they were born." "Blacks as Fishermen" is interesting rather as a study of facts. J. S. G.

FIG. 1.—A banyan tree: stilt and buttress roots. From "Tropic Days.

AGRICULTURAL RESEARCH IN AUSTRALIA.

WITH the growing demand for intensified agricultural production occasioned by the war has come the realisation of the inadequacy of the existing provision for agricultural research in all parts of the world. The movement towards more generous and systematic provision is by no means confined to the older, more highly cultivated countries, but is perhaps even more active in those more distant parts of the globe where increased production on a large scale by extensive methods is still possible. Few countries, indeed, have set about this particular task of reconstruction more systematically and energetically than the Commonwealth of Australia, the prosperity of which is so closely bound up with the fortunes of her great agricultural industry.

For three decades or more Australian agriculture has had the advantage of liberal provision for agricultural education and research under the ægis of the various State Departments of Agriculture. These Departments have not only established agricultural colleges with associated experimental farms, but other farms and laboratories for general experimental work have also been developed, as well as centres for the specialised investigation of different branches of agriculture, such as viticulture, dairying, sugar production, and irrigation.

Most of the experimental farms are of great size, and admirably equipped for field experimental work. The Roseworthy Agricultural College-Experimental Farm in South Australia covers about 1600 acres, with 100 acres in permanent experiments; the Hawkesbury College Farm in New South Wales extends to 3500 acres, with more than 200 acres of experimental plots; whilst the Victorian State College Farm at Dookie has an area of about 4500 acres, with some 400 acres devoted to experimental work with cereal and fodder plants. In all there are in the various States about thirty experimental stations, with a total farm area of nearly 50,000 acres, in addition to numerous experimental orchards, vineyards, and other areas.

Armed with this extensive equipment, the Australian State and college workers have achieved very substantial advances in agricultural production, of which the development of new varieties of wheat deserves special mention. Since the federation of the States into the Commonwealth in 1901, however, there has been a growing feeling in favour of a central Federal organisation to secure greater co-ordination of effort and reduce the overlapping inevitable under the existing State systems. Many important problems that are receiving or require attention are common to the greater part of Australia, and could obviously be dealt with more effectively and with greater economy of means and men by a central organisation than by independent investigation in the different States.

A similar need has also been felt in connection with other industries, and the whole movement has culminated in the recommendation by the Commonwealth Advisory Council of Science and Industry for the immediate creation of a permanent Commonwealth Institute of Science and Industry, organised purely for research, and entirely dissociated from routine administrative work. The executive committee, under Prof. D. Orme Masson, and including other prominent agricultural investigators, has devoted a large share of its attention to agricultural research, and in the final report has formulated a definite programme of agricultural research for the initial years of operation of the institute, which includes studies in soil fertility, plant pathology and insect pests, plant breeding, animal breeding and feeding, animal diseases, cotton and flax growing, forestry, and other subjects. The Advisory Council has pressed for immediate action, and the general features of the organisation and lines of work have already received the provisional approval of the Commonwealth Government, and doubtless formal adoption will not long be delayed.

Among the many activities of the executive committee of the Council, special interest attaches to the week's conference of agricultural men of science held under its auspices in Melbourne in November, 1917, and reported in full in Bulletin No. 7 of the Advisory Council. Limitations of space prevent more than the briefest reference to the varied programme dealt with by the conference, the topics discussed including cereal breeding, the acclimatisation of plants, the utilisation of Australian phosphate deposits, the tobacco and sugar industries, fibre-plants, native grasses and fodder plants, and crops for the production of power alcohol.

One session was devoted entirely to a general discussion on the endowment and co-ordination of agricultural research in the Commonwealth, papers on the subject being read by Prof. A. J. Perkins, Director of Agriculture in South Australia, and Prof. R. D. Watt, professor of agriculture in the University of Sydney.

Prof. Perkins urged that the research worker should be free from State control, and advocated the development of agricultural research at the universities rather than in the State agricultural colleges. For this purpose central research institutions, financed by the central Government, should be located at the different universities. The University of Adelaide has already secured land for the purpose, but financial assistance is required to develop the scheme.

Prof. Watt also emphasised the importance of developing agricultural research at the universities, but pointed out that the rate of increase in the number of trained research workers must be slow, owing to the small numbers of agricultural students at the universities and the consequent limitations of staff. He hoped for better conditions in this respect after the war, especially if provision could be made for research scholarships and fellowships.

The shortage of adequately trained research workers was generally agreed to be one of the chief difficulties in the way of the necessary expansion of research activities, and a resolution was adopted requesting the Advisory Council to bring the need for training more research workers to the attention of the universities. The difficulty is by no means peculiar to Australia, and all concerned with the promotion of agricultural research will await with interest the steps taken in Australia to solve this particular problem.

REGINALD PHILIP GREGORY.

BY the death on Sunday, November 24, of Mr. Reginald Philip Gregory, from pneumonia following influenza, the University of Cambridge has lost an able botanist, a man for whom young and old felt a warm affection. Mr. Gregory was born on June 7, 1879, at Trowbridge, Wilts; he received practically the whole of his early education in a preparatory school established in 1887 by his mother at Weston-super-Mare, where special attention was paid to natural history. At the suggestion of Prof. Reynolds, of University College, Bristol, from whom he received some additional training, he successfully competed for an entrance scholarship at St. John's College, Cambridge, in 1897. He came into residence in October, 1898, and in 1900 obtained a first class in the first part of the Natural Sciences Tripos; in

1902 he gained a first class in botany in the second part of the Tripos.

In 1904 Mr. Gregory shared the Walsingham medal with the late Dr. Keith Lucas, and in the same year he was elected a fellow of his college. In 1907, after serving five years as a demonstrator in the botanical department, he was elected to a University lectureship. In 1912 he became tutor of St. John's, an appointment which he was able to hold with the University lectureship; and in the same year he married Joan, the second daughter of Mr. T. E. Bisdee, of Hutton Court, Somerset, by whom he had three children. From July, 1915, to July, 1917, he held a captain's commission in an officer cadet battalion at Cambridge, which he relinquished to join the 1st/6th Battalion of the Gloucestershire Regiment as a second-lieutenant. After about a fortnight in the front line he was gassed, and from the effects of this he never completely recovered; he was discharged from the Army in October of this year, and, though still far from well, resumed his college and university duties.

Mr. Gregory was one of a group of students who were stimulated by the teaching and enthusiasm of Prof. Bateson to take up different branches of genetics; it was mainly with cytological problems that his researches were concerned. He was the author of several papers, some of which were published in the Proceedings of the Royal Society in collaboration with Prof. Bateson. His most important contributions were those dealing with the genetics and cytology of giant races of Primula, published in the *Journal of Genetics* (1911) and in the Proceedings of the Royal Society (1914). His work demonstrated the striking fact that some forms of Primula exhibit the giant character not only in the plant-body as a whole, but also in the constituent cells. The results obtained constituted a definite advance in our knowledge of phenomena connected with the reduplication of certain terms in a series of gametes. His researches also included the investigation of heterostylism, habit, leaf-form, and flower colour in *Primula sinensis*, the seed characters of Pisum, reduction-division in ferns, forms of flowers in Valeriana, and other subjects.

Mr. Gregory was a good all-round botanist, who inherited from his mother (whose work on the genus Viola is well known to systematists) a love of natural history. He had already established for himself an honourable position as an original investigator, and those who knew him best looked forward with confidence to still greater achievements in the future. He was a man who would never grow old; he enjoyed life in the best sense, and endeared himself to undergraduates and older associates by his unselfishness and joyous, openhearted character. His place will be hard to fill, particularly in these days when there is an exceptional need for virile teachers and men of wide and strong human sympathies.

A. C. SEWARD.

NOTES.

IN his speech at Wolverhampton on Saturday last the Prime Minister made a noteworthy declaration in regard to the application of science to agriculture—a declaration which would appear to adumbrate something more than a passive policy of commendation. "Scientific farming *must* be promoted," he said; and in another passage he spoke of utilising the capacity of the soil to a greater extent by the application of scientific principles. There is a certain vagueness in these statements, and until concrete proposals are put forward it is difficult to appraise their meaning and value. One obvious way of adding to the capacity of the soil would be to promote the use of artificial fertilisers, and, seeing that Mr. Lloyd George also spoke of the need for a "national supply of fertilisers," it seems probable that what he had in mind in speaking of scientific farming was the extended use of artificial manures. The suggestion—or is it a decision?—to have a national supply of fertilisers foreshadows a new departure in State policy of great import. It is to be hoped that in applying science to farming the Prime Minister will bear in mind the need for encouraging research in the sciences bearing on agriculture.

A DEPUTATION from the National Sea Fisheries Protection Association is to wait upon the Right Hon. R. E. Prothero, President of the Board of Agriculture and Fisheries, as we go to press, to urge that the evolution and general direction of a fisheries policy for the whole nation should be entrusted to a Minister of the Crown who will be able to give to the subject his undivided interest. The industry is of prime importance, and a strong case can be made out for the constitution of a separate Ministry to be concerned with its interests and development. Mr. Hoover, the United States Food Administrator, whom we welcome among us, has warned us time and again of the fact that for many years to come the world must go short of beef. The impending meat famine, he tells us, started in 1907. In meat-eating countries the population increased. The demand for meat rose; prices rose; stockmen yielded to the temptation, and slaughtered cows, heifers, and calves which should have been kept as *reproducteurs*. The herds have further been diminished by periods of drought in Argentina, Australia, and North America, and by internecine strife in Mexico and Europe. Whatever happens, we shall be short of meat for years to come. That is one ground on which the National Sea Fisheries Protection Association bases its claim for reform of the fisheries administration of this country. The other considerations are: that fishermen will not undertake the catching of fish—a herculean labour of unending toil—unless there is a good living to be made out of fishing; that their industry has been so disorganised during the war that nothing short of national assistance can save it; and (a self-evident proposition) that these islands must maintain their fishermen communities or "go under." Such, in brief, is the case which the association presents to the Government. It has been worked out in detail in a printed memorandum which we commend to the study of our readers. Copies can be obtained from the secretary of the association at Fishmongers' Hall, E.C.4. We wish well to the deputation and to Mr. Prothero. Meanwhile, we note that there is a great degree of unanimity in the demand of the industry for a central Ministry to supervise the work of the English and Scottish fisheries services, and that the fishermen of Canada, France, and Germany are demanding similar consolidation of effort from their respective Governments. Fishermen know their business, and there is a strong presumption that their demands are reasonable.

THE *Times* for November 25 gives an interesting forecast of the report of the Civil Aerial Transport Committee, which has now been presented to Parliament, but will not be published until the New Year. It will be remembered that this Committee was appointed in May, 1917, to consider the regulation of commercial air traffic and the possibility of employing existing machines and *personnel* for commercial purposes after the war. The Committee has divided itself into various sub-committees, dealing with various issues, and the main conclusions reached, as foreshadowed in the *Times*, are here summarised. With regard to the sovereignty of the air, it has been recommended that any country must exercise sovereign rights over the superincumbent air if commercial aviation is to be properly regulated and controlled. Such points as the qualifications for using aircraft, registration, and the problems arising in connection with damage caused by aircraft have been thoroughly discussed. In dealing with the possibilities of existing machines, four types have been considered, represented by the Handley-Page, the de Haviland, the R.E.8, and the Sopwith "Pup." The first two types are naturally the most interesting, being both capable of carrying considerable loads. The lighter machines may, however, be of much assistance to commercial activities in connection with the rapid transport of passengers and small quantities of goods.

THE Committee referred to above expresses the opinion that speed of aircraft is probably the chief factor for commercial success, especially for inland routes, where an express train service is available as an alternative. For isolated spots and sea passages speed will not be so important. A speed of 100 miles per hour is suggested, and this is sufficiently difficult to attain with heavy machines on account of the high landing speed involved, especially if the wing-loading is high. The Committee directs attention to this point, stating definitely that a high loading is a necessity for commercial success, and suggesting that a development of air-brakes or arresting devices may meet the difficulty. Night-flying is considered essential, particularly in relation to mail services, and the development of existing facilities should be encouraged. Those interested in commercial aeronautics will await with interest the publication of the full report, but the above brief remarks will suffice to show that the difficulties to be surmounted are considerable, and will tax the powers of designers to the utmost. The wonderful progress that has been made with military aircraft should prove a great stimulus, and if similar facilities for experimental research can be applied to the commercial problem, we may well look forward to a period of rapid development and success.

RAPID strides have been made by the Meteorological Office in weather knowledge during the progress of the war, and the information available for the newspaper Press is vastly superior now to that of four years ago. The rapid development of the Air Service has entailed a more minute study of the upper air, and facts of really scientific value are being secured. It is now suggested that the changes in atmospheric pressure at the earth's surface are controlled by the atmospheric pressure at the elevation of about five or six miles. Pilot-balloon observations are now made daily in many different parts of the British Isles, and these are charted for the several elevations up to 10,000 ft. or 15,000 ft. Since the weather has again become public information, the pilot-balloon observations have shown many points of interest. During the progress of a storm area on its north-easterly course to the westward of Ireland on November 20 the surface-wind at Valencia was travelling at twenty-nine miles an hour, whilst at 2000-ft. elevation it was travelling seventy miles an hour. On November 22, with a surface-wind of thirteen miles an hour, the rate per hour at 4000 ft. was fifty-three miles, the direction in both cases being south-easterly.

THE Registrar-General's return for the week ending November 16 shows a very decided decrease in the deaths in London from influenza, the number being 1665, while for November 9 it was 2433, a decrease of 768. At many places in the English provinces the complaint is still virulent, and the deaths show no abatement. The death incidence at the several ages is well maintained, the deaths between the ages of twenty and forty-five being 46 per cent. of the total, and the deaths below forty-five years being 77 per cent., whilst above forty-five years the percentage is only 23. Influenza was responsible for 49 per cent. of the deaths from all causes during the week, pneumonia for 14 per cent., and bronchitis for 7 per cent. For the whole six weeks of the epidemic influenza has caused 48 per cent. of the deaths from all causes, pneumonia 12 per cent., and bronchitis 6 per cent. Chicago, with nearly two-thirds of the population of London, had 571 deaths from influenza in the week ending October 12, when London had eighty deaths only, showing that the disease was rampant earlier in Chicago.

AN appeal has been issued by the president of the Royal Society of Antiquaries of Ireland, supported by representatives of other associations interested in Irish antiquities, on the subject of an inventory of the local archæological remains. The writers point out that the antiquities of Ireland possess more than local interest, and that in comparison with those of Great Britain they are more numerous. In recent years, owing to the changing conditions of land tenure, the abandonment of old superstitions, the imperfection of the system of local education, the extension of tillage, and other causes, much damage has been done to these monuments. It is pointed out that in 1908 three Royal Commissions were appointed for the purpose of making detailed inventories of the ancient monuments of England, Scotland, and Wales, as a result of which a large mass of important information has been collected and published. But, so far, no steps have been taken to institute a similar survey in Ireland, and an appeal by the Royal Society of Antiquaries and the Royal Irish Academy has been rejected. The request of this important body of antiquaries is clearly reasonable, and will, we have little doubt, receive hearty support from antiquaries in Great Britain.

IT has long been recognised that whilst the open fire is at once attractive, and furnishes practically the only means of ventilation of ordinary dwellings, its heat efficiency is remarkably low. The shortage of coal and its high price—the latter a legacy which will probably remain to the householder—furnish ample incentive to improve the efficiency of the domestic grate, but the replacement of even a small part of the number by more scientifically constructed appliances is obviously out of the question. Landlords will not go to the expense to save tenants' pockets, and tenants are equally averse to incurring expense which in most cases would benefit others. Means may, however, be found to improve the efficiency of existing grates, and Prof. C. V. Boys has invented an economiser in which the flue-gases are diverted on their way to the chimney through two upright cylinders, standing one on each side of the fireplace, each cylinder surrounding a concentric pipe which is open above and below. The flue-gases pass through the annular space thus formed on their way to the chimney, heating the inner tube and causing a current of warm air to be discharged into the room; also the surrounding air is warmed by contact with the exterior of the flue-gas chambers. The fire remains visible and radiates as usual. It is admitted that such a device is not altogether ornamental, but people may be willing to accept this disadvantage in view of the advantage of added warmth for a given consumption of fuel.

THE death is recorded in *Science* of Prof. W. L. Hooper, head of the department of electrical engineering at Tufts College, Mass. Prof. Hooper had been a member of the faculty at Tufts for thirty-five years, and was acting president in 1912 and 1913.

THE death is announced, in his seventy-fourth year, of Prof. William Main, formerly professor of chemistry in the University of North Carolina. Prof. Main was one of the pioneers in copper and lead mining in the United States. He invented the lead-zinc storage battery, and is said to have been the first to apply the storage battery commercially to the propulsion of street-cars. In recent years he had been chiefly employed as an expert in technical cases before the courts.

LT.-COL. LLEWELLYN LONGSTAFF, whose death at the age of seventy-seven is announced by the *Times*, was known to geographers chiefly for his generous support of Antarctic exploration. The funds for the projected national expedition were growing so slowly that there seemed little hope of enough being collected to equip even a modest expedition when in March, 1899, Col. Longstaff sent a contribution of 25,000*l*., which, with contributions already in hand, guaranteed the sailing of the ship. Two years later the expedition sailed in the *Discovery* under Capt. Scott. Col. Longstaff also contributed to Capt. Scott's last expedition. Most of his life he devoted to business, and he was keenly interested in volunteering. For more than forty years he had been a fellow of the Royal Geographical Society, and served for some time on its council. His eldest son, Capt. T. G. Longstaff, is well known for his travels and explorations in the Caucasus, Himalayas, and Tibet.

THE success of the British Scientific Products Exhibition, held at King's College, London, during the past summer, has led the British Science Guild to decide to organise another exhibition next year. The main object of the new exhibition will be to stimulate national enterprise by a display of the year's progress in British science, invention, and industry. Further particulars will be available in due course. A large part of the recent exhibition has been transferred to Manchester, where it will be on view at the Municipal College of Technology in a few weeks' time.

THE Cecil medal and prize of 10*l*. of the Dorset Field Club will be awarded in May next for the best essay on "explosives used in warfare from the time of the Crusades to the present war, giving details (unobjectionable from a military point of view) of each invention, and the chemical proportions of the substances used in each case, commencing with gunpowder and Greek fire." The competition is open to persons between the ages of seventeen and thirty-five on May 1, 1919, either born in Dorset or resident not less than a year between May 1, 1917, and May 1, 1919. Particulars are obtainable from Mr. H. Pouncy, Midland Bank Chambers, Dorchester.

THE *Museum Journal*, published by the University of Pennsylvania (vol. ix., part 2, June, 1918), is largely devoted to a study of works of art from the Far and Nearer East. In primitive Chinese ritual bronze vessels were used to hold the food and drink offered to the spirits of the earth and air and the manes of departed ancestors. Two valuable specimens of this class of vessel, one belonging in all probability to a period well back in the first millennium before our era, the other dated during the twelfth or eleventh century B.C., are described. Of these the ornamentation, though bizarre, is singularly effective in conforming to the exigencies of the space to be covered. The Bronze age in China is believed to have drawn to a close about the middle of the first millennium before our era. For religious purposes, however, bronze continued to hold its own, and it was not for another millennium, or until the sixth or seventh century A.D., that the art of the bronze-worker may be said to have attained its apogee with the casting of those wonderful gigantic statues which characterised the religious enthusiasm prevailing in China of the Northern Wei (A.D. 386–535) and T'ang (A.D. 618–907) dynasties, of which the sole remaining example in the world to-day is the great Daibutsu at Nara, the ancient capital of Japan.

FURTHER light on the respiration of larval dragonflies is afforded by Mr. Joseph H. Bodine in the Proceedings of the Academy of Natural Sciences of Philadelphia (vol. lxx., part 1). The author shows that these larvæ breathe by means of the rectum from the time of hatching until transformation. The so-called tracheal "gills" serve but as rudders during locomotion, and take no part in respiration, as is shown by the fact that they may be removed with impunity. That respiration takes place through the skin of the larva he regards as improbable, since any oxygen thus absorbed would be quite insufficient for respiratory purposes.

THE significance of specific structural characters as between nearly related species is variously interpreted by evolutionists, who are prone, in discussing this theme, to neglect the work of the systematists who are providing an immense store of material for analysis. Larval characters are especially interesting in this regard, as will be manifest on a careful examination of the enlarged figures of the mouth-parts of tadpoles given by Dr. N. Annandale in his papers on "Some Undescribed Tadpoles from the Hills of Southern India" and on "The Tadpoles of the Families Randidæ and Bufonidæ Found in the Plains of India" in the Records of the Indian Museum (vol. xv., part 1).

As is well known, surgeons insert grafts of living bone to supply defects caused by destructive injuries, but there is a difference of opinion as to the fate of such bone grafts. The opinion most usually held is that they always die, and that they merely help recovery by supplying a framework which is invaded by neighbouring living-bone cells. The view that grafts are purely passive in their action is supported by experiments reported by MM. J. Nageotte and L. Sencert (*Comptes rendus*, October 21). So far as all forms of connective tissue are concerned, the authors find that grafts which have been preserved in formalin or alcohol for a month or more serve all the purposes of a living graft. The dead fibre of the graft unites with the living fibre of the host, so that the point of union cannot be detected. The authors excised from the common extensor tendon of a dog's foot a piece 2·5 cm. long, and stitched in its place a corresponding piece of tendon which had been kept in alcohol for a month. When the dog was killed three months later it was found that the dead graft had become so perfectly united with the original tendon that its position could be detected only by the marks of the stitches. It is unnecessary to emphasise the importance of these observations to military surgeons.

The Eskimo of Greenland have a term, "savssat," to denote the crowding of animals in large numbers into a small space. This phenomenon has been referred to by several writers on Greenland. Mr. M. P. Porsild, director of the Danish Arctic Station at Disko, has some notes on the subject from personal observations in Disko Bay in the *Geographical Review* for September, 1918 (vol. vi., No. 3). In the winter of 1914-15 the ice-covering began to form at the outer end of Disko Bay, and the inner parts were closed later. This resulted in many narwhals being caught at the head of the bay and in Waygat Sound. The Eskimo discovered belts of thin ice in which the narwhals had broken breathing-holes. Around these holes the Eskimo collected and slaughtered the animals as they appeared. Allowing for carcasses lost, Mr. Porsild calculates the total number of narwhals killed at two "savssats" at more than a thousand. It is interesting to note that Mr. Porsild, who has had good opportunities to judge, denies that the male narwhal uses his tusk to make breathing-holes in the ice. These, he insists, are made by the top of the head. Eskimo confirm this view.

The October issue of the *Journal of the Board of Agriculture* is essentially a women's work number, and gives an interesting survey of the great contribution made by women to the national food production effort of the past two years. Separate articles descriptive of various phases of the work of the Women's Branch of the Food Production Department are contributed by Miss Meriel M. Talbot, the Hon. Mrs. Alfred Lyttelton, and Miss M. M. McQueen, the principal officers of the branch. The work of the women of Wales is described by Mrs. M. S. Roberts; the work of women's institutes by Miss G. Hadow, vice-chairman of the National Federation of Women's Institutes; whilst Miss S. C. Hamlyn contributes an interesting account of a successful Devon experiment in the running of a farm entirely by women. The series is prefaced by a very suggestive article by Sir Daniel Hall on the position of women in agriculture. The problem of providing suitable openings for the many trained women who are now determined to remain upon the land and take up farming as a career he believes can best be solved by large farms worked entirely by women upon co-partnership lines. The small holding he regards as too speculative for the woman with little capital, and demands, moreover, an expenditure of physical energy which is beyond the powers of the average woman. The return to the small-holder is probably no greater than can be secured for the individual woman worker on the large co-partnership farm, provided it is carefully selected and well managed. He suggests that a trial should be made with a farm of about five hundred acres, devoted mainly to fruit-growing and market-gardening. Estimates are given which indicate that with reasonable success, after making due provision for interest on capital, management, wages, and reserve, a surplus should be available for distribution which would raise the weekly wage from 25*s*. to 40*s*. The provision of living accommodation and social amenities for the women workers is considered, and suggestions are given for the establishment and organisation of a community system, including communal buildings and cottages.

We have received a copy of the first issue of the *South African Geographical Journal*, which is the publication of the South African Geographical Society formed last year at Johannesburg. The journal is edited by Mr. J. Hutcheon, of the School of Mines and Technology, who contributes an introductory article on the aims of the society. It is hoped "to raise the standard and to safeguard the interests of the subject and those teaching it, to encourage geographical research," and to arouse interest in geography in South Africa. The society has in view the institution of travelling scholarships and the organisation of long-vacation excursions to India, Australia, Europe, etc. The journal is mainly occupied with reports of lectures delivered before the society, but contains an important article by Prof. J. W. Bews on "South African Phytogeography." The author gives the characteristics and distribution of fifteen types of vegetation, which he suggests as the basis of a botanical map of South Africa.

In the *Scientific American* for October 12 Mr. E. C. Horst describes a new industry which has sprung up in California with the support of the American Government. This is the drying of vegetables for export. It is done by placing slices of cleaned fresh vegetables, grown in the vicinity, on perforated trays packed in a room through which a current of warm, dry air is driven by fans. This slowly extracts the 65 to 85 per cent. of moisture the vegetables contain without, it appears, destroying their flavour when water is afterwards added to them. The dried vegetables are packed in cartons and tins of about 10 lb. weight. Millions of these tins have been sent to France, and one of the establishments on the Pacific coast now employs several thousand persons.

The Board of Science and Art, New Zealand, has decided on the bi-monthly publication of a *New Zealand Journal of Science and Technology*, together with additional bulletins in which papers too long for the ordinary journal will appear. This is an extension of the scheme authorised by the Government for the co-ordination of all papers and reports of a scientific nature. Already the official issues include the *Journal of Agriculture*, and bulletins and palæontological bulletins of the Geological Survey Department, and the bulletins of the Dominion Museum. The first of the new series of bulletins records the investigations of H. Rands and W. O. R. Gilling, national research scholars of the Canterbury University College, Christchurch, on the use of New Zealand brown coals, of which Prof. Park estimated the reserves at 521,000,000 tons, and of which only about 13,000,000 tons had been mined to the end of 1913. The two sections of Bulletin I. deal with the use of these brown coals in gas producers and the products yielded by low-temperature distillation.

A pamphlet describing the Fahy permeameter has been received from Mr. E. H. Alexander, of Coleshill Street, Birmingham, who is the agent for their sale in this country. The great commercial importance of a knowledge of the magnetic qualities of samples of iron and the time and labour involved in testing them by the standard ring method has led to the invention of numerous permeameters. Searle's magnetic square was one of the earliest types, and modifications of Ewing's yoke method have been extensively used. The Burrows permeameter has been officially adopted by the American Society for Testing Materials. In the Fahy permeameter we have an **H**-shaped piece of iron, the magnetising coil surrounding the horizontal bar, and the magnetic flux returning by the two gaps at the top and bottom of the vertical lines. One of these gaps is spanned by the sample steel bar to be tested, and the magnetising forces across this sample and across the remaining air-gap are adjusted by means of compensating and test coils until they have the same value. Hence the magnetising force on the bar—which is always the difficult thing to measure—can be found. The magnetic induction is measured in the ordinary way by reversing the current in the magnetising coil and noting the deflection produced on a ballistic galvanometer in series with a search coil. It would appear from the tests made by the U.S. Bureau of Standards that the accuracy of the permeameter is of the order of 5 per cent. Since the magnetic properties of a strip of transformer steel usually vary by this amount at different parts along its length, the accuracy obtained is satisfactory. So far as we know, however, the Drysdale permeameter is the only one that professes to test the magnetic properties at different parts of a large block of iron. In this a special tool is used to bore into the iron, so that parts of it can be tested *in situ*.

THE line of the New Zealand Government railways between Christchurch and Timaru is the easiest stretch in New Zealand; it is straight and almost level for nearly the whole distance, but express trains frequently involve loads of more than 400 tons behind the tender, and the prevalent north-west gales make flange resistance heavy. The gauge is 3 ft. 6 in., and the trains were formerly worked by four-cylinder balanced, compound locomotives of the Pacific type. *Engineering* for November 22 contains an illustrated account of some new non-compound engines for this service, designed by Mr. H. H. Jackson, chief mechanical engineer. Superheated steam of 180 lb. per sq. in. pressure is used, with 54-in. coupled wheels and 17 in. by 26 in. cylinders. The valve gear is of the Walschaert type, with piston valves. The new engines have been tested against the best compound engines available, and show a saving of 20 per cent. in water and 33 per cent. in coal, including coal used in making up the fire each morning and during the two hours' stand over at Timaru. Part of the saving is undoubtedly due to the boiler, which is easily the best steaming boiler seen on a locomotive in New Zealand, and of this saving part again is directly due to superheating. The records of the hauling performances are also very good.

THE current issue of Mr. C. Baker's quarterly list of second-hand instruments for sale or hire will repay careful examination by scientific workers. The catalogue contains descriptions of more than 1500 pieces of scientific apparatus, nearly all of which can be examined at 244 High Holborn, W.C.1. Great prominence is given in the list to microscopes and accessories, astronomical and terrestrial telescopes, theodolites, spectroscopes, projection and photographic apparatus, as well as to general physical apparatus.

OUR ASTRONOMICAL COLUMN.

COMETS: WOLF'S AND BORRELLY'S.—Ephemeris of Wolf's comet for Greenwich midnight:—

	R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
Dec. 2	22 19 27	2 53	0·2003	0·1204
6	22 30 22	3 17	0·1996	0·1294
10	22 41 26	3 36	0·1994	0·1367
14	22 52 34	3 51	0·1992	0·1480
18	23 3 47	4 1	0·1995	0·1576
22	23 15 2	4 6	0·2000	0·1672
26	23 26 19	4 8	0·2008	0·1769
30	23 37 34	4 5	0·2019	0·1867

The comet reaches perihelion on December 13, but, owing to its increasing distance from the earth, it is not likely to be brighter than the 12th or 13th magnitude.

The following is an approximate ephemeris of Borrelly's comet for Greenwich midnight:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Dec. 4	7 3 13	31 46	0·1497	9·6795
8	7 3 2	36 20		
12	7 2 12	40 45	0·1545	9·6832
16	7 0 35	44 59		
20	6 58 5	48 55	0·1610	9·7043
24	6 54 11	52 25		
28	6 49 50	55 29	0·1687	9·7382

The comet is less than half an astronomical unit from the earth during the first half of December. It should be an easy object in small telescopes. The high north declination renders the comet observable throughout the night.

THE ORBIT OF 83 AQUARII.—For the second time Dr. R. G. Aitken has deduced the orbit of a visual binary star, all the work on which, including the discovery and measurers, has been carried out by himself (Lick Observatory Bulletin No. 317). The star in question is 83 Aquarii (=A 417), and was noted as a close pair with components of equal brightness in 1902. Until 1912 the angular motion was nearly uniform, but in the last few years the motion has been extremely rapid, and the apparent distance so small as to make the pair difficult to measure even in the 36-in. telescope. The provisional elements of the orbit, with their computed probable errors, are as follows:—

$P = 23{\cdot}82 \pm 1{\cdot}37$ years	$\omega = 261{\cdot}3° \pm 5{\cdot}4°$
$T = 1917{\cdot}68 \pm 0{\cdot}20$ year	$i = \pm 56{\cdot}35° \pm 4{\cdot}1°$
$e = 0{\cdot}404 \pm 0{\cdot}016$	$\Omega = 21{\cdot}6° \pm 2{\cdot}4°$
$a = 0{\cdot}245'' \pm 0{\cdot}005''$	

THE SPECTRUM OF NOVA AQUILÆ.—An important contribution to the spectroscopic study of Nova Aquilæ has been made by Dr. J. S. Plaskett, who has obtained a large number of photographs with a single-prism spectrograph attached to the new 6-ft. reflecting telescope of the Dominion Astrophysical Observatory at Victoria, B.C. (Journ. R.A.S. Canada, vol. xii., p. 350). Some of the photographs are remarkable for their great extension into the ultra-violet, as many as nineteen lines of the hydrogen series having been measured on June 19. The description of the changes recorded agrees closely with the accounts given by other observers. A change towards the nebular stage was noted on June 20, when the lines 5007, 4685, and 4363 began to show, and on July 11 the nebular stage was strongly marked. The displacement of the first set of hydrogen absorption lines increased at $H\gamma$ from 20·5 A on June 10 to 25·4 A on June 24, and from June 10 to June 15 there was a second set having a displacement of 33 A to the violet at $H\gamma$. The measured positions of these lines agree with the positions computed by Balmer's formula when the constant is changed from 3646·13 to 3625·78 for the first and to 3618·4 for the second component on June 15. The positions of some sixty-five metallic lines, identified chiefly as enhanced lines of Ti, Fe, Cr, Sr, Sc, and V, were measured on the spectra from June 10 to June 15, and it has been shown that the displacements of these were also proportional to the wave-length, and were exactly the same as those of the hydrogen absorption lines. Dr. Plaskett considers it more likely that the displacements are due to some physical cause acting in the same manner on the molecules of all the elements involved than to velocity.

ORBITAL DISTRIBUTION OF THE ASTEROIDS.

PROF. K. HIRAYAMA has published further papers on this subject (*Annales de l'Observatoire Astronomique de Tokyo*, Appendices 2, 4, 5, and 6), which was referred to in a note in NATURE for March 21 last (vol. ci., p. 53). These papers may be divided into two parts: (1) an examination of the various kinds of libration that may take place; (2) a study of the effect of a resisting medium on the asteroid motions.

The first portion is based on Prof. E. W. Brown's paper in Monthly Notices, R.A.S. (vol. lxxii., p. 609). Taking l, n, ϖ, e as the mean longitude, mean motion, mean longitude of perihelion, and eccentricity of an asteroid nearly commensurable with Jupiter, and denoting by accented letters the corresponding elements of Jupiter, n_0 is a quantity nearly equal to n, such that $n_0/n'=s/s'$, where s, s' are small integers. Then n/n_0-l is denoted by x, and $s'l-sl'+(s-s')\varpi$ is denoted by θ. In the cases of the first order $s-s'=l$, it is shown that the angle θ may either revolve through the whole circle or librate over a limited arc, according to the values of the constants; there are three types for either revolution or libration, viz. they may be on the negative side of x, on both sides of x, or on the positive side of x.

These rules are applied to a large number of orbits, and the following general results are given:—(1) All the asteroids with n less than 500″ librate, forming groups near the commensurable points 1/1 (the Trojan group), 3/2, and 4/3. The last case is that of Saturn's satellites Hyperion and Titan, the conjunctions of which always take place near Hyperion's aposaturnium, thus avoiding near approaches. (2) The asteroids with n above 500″ generally avoid the libration, and thus the gaps at 2/1, 3/1, 5/2, etc., are produced.

The author then proceeds to consider the effect of cosmic dust revolving in circular orbits about the sun on the asteroids. He points out that such dust is likely to be pretty dense in the sun's neighbourhood, and less dense with increasing distance. It is probably eliminated from the regions near the orbits of the planets, but may be present in the asteroid zones. Assuming the resistance to an asteroid to vary as the square of the relative velocity, it is shown that the perturbation of a varies as e^3, that of e as e^2, those of the other elements being insensible. A difficulty arises that if these perturbations are sensible for the asteroids, they should be far more so for comets, the eccentricities of which are so large; it is suggested that, owing to the loose constitution of comets, the result might be partial disintegration instead of a bodily shift. The general effect on asteroid motion is shown to be that the first two types both of libration and revolution are not permanent, but tend to degenerate to the third type. The different cases are discussed in a manner that cannot be reproduced in a brief summary.

In Appendix 6 Prof. Hirayama announces the interesting discovery that there are three families of planets the orbits of which are inter-related in such a manner as strongly to suggest a common origin for each family. He calls them the Koronis, Eos, and Themis families, using in each case the name of the earliest-known member of the family. The Koronis family consists of sixteen asteroids, the mean motion of which lies between 720″ and 740″, and inclination between 0° and 4°, ϕ being also between 0° and 4°. The corresponding limits in the Eos family, which has nineteen members, are 671″ to 682″, 8° to 11°, 2° to 7°. Those in the Themis family, which has twenty-two members, are 622″ to 653″, 0° to 3°, 7° to 12°. Plotting the poles of the orbit-planes of each family, they are found to lie nearly on the circumference of a circle the centre of which is the pole of Jupiter's orbit-plane. Further, taking longitude of perihelion and eccentricity as polar coordinates, and plotting a further series of points, these also lie approximately on the circumference of a circle the centre of which lies in the same direction from the origin as the corresponding point for Jupiter's orbit, but its distance from the origin is less than that of the latter point in the ratio of (about) 2 to 3. The author shows that these features would be explained by the perturbations produced by Jupiter, on the assumption that each family once formed a single body or swarm, which afterwards broke up. The discovery sheds new light on the history of the asteroids.

OFFICERS' UNIVERSITY AND TECHNICAL CLASSES.

THE Ministry of Labour some months ago arranged for officers not fit for service to be allowed to spend their time in training for Government posts or for the work they will undertake when released from service. The armistice will cause a great development of this work, which will now include discharged officers as well.

The training already given has been very varied; most of it has been given in universities or technical colleges, but where it has seemed desirable officers have been placed with commercial or industrial firms. While training they receive full pay and allowances, but have to find the fees for the courses they are taking. In most of the universities members of the O.U.T.C. are studying; a large number are taking up engineering, while some are pursuing curricula in the faculties of arts and science. Lately, training for business has been included; this has been developed in Birmingham, and further courses are in process of arrangement at London, Edinburgh, and Bristol.

The courses are "intensive" in most cases, though a proportion of the officers are aiming at a degree. Most of the universities have, very rightly, decided that where their preliminary education is very good they may be admitted to matriculation without examination, and, where possible, excused one year of study and the first examination for a degree, so that they may qualify for graduation after two years of study.

The complete courses are likely—at least, in science and technology—to yield more satisfactory results than the "intensive" ones, which usually last for about ten weeks, and can, therefore, only give satisfactory training to those who merely need to refresh the knowledge they had already gained or to occupy their minds during convalescence.

The Ministry of Labour has assisted universities and colleges to undertake this work by lending them, free of charge, qualified invalided officers to act as temporary lecturers and demonstrators; otherwise much of the work done would have been impossible with the depleted staffs available. Often the officers lent have been graduates who were former students of the institutions which borrowed them.

The Ministry of Pensions will give aid to discharged officers and men who wish to benefit by this scheme and whose means are insufficient to enable them to complete their studies, if these were interrupted by the war.

The Controller of the Department to which this work is entrusted is Mr. G. Home McCall, to whose initiative and energy the success it has already attained is largely due.

J. WERTHEIMER.

A SCIENTIFIC RESEARCH ASSOCIATION.

IN the spring of this year steps were taken at Cambridge to form a scientific research association, and a provisional executive committee was appointed to bring the matter before a limited number of selected representatives of the various branches of science throughout the country. The aims of the association were defined as follows:—

(1) To be prepared to offer advice and information to those who wish to devote themselves to scientific research.

(2) To be prepared to give advice to bodies administering public funds for research as to the most useful ways in which such funds could be applied.

(3) To impress upon the attention of the public the importance of scientific research, and thus to promote a wider understanding of the fundamental value of scientific method.

(4) To consider the possibility of organising a scheme of permanent national endowment so as to afford opportunities for young and promising students to establish themselves in research work, and to secure to the ablest of these the possibility of a career devoted mainly to the continued pursuit of scientific investigation.

Widespread and representative support was obtained for the project, seventy fellows of the Royal Society being among those who signified their adhesion to these aims, and this has encouraged the provisional committee to proceed with the work of drafting an outline of the proposed constitution and organisation of the association. This draft, with an explanatory statement of the aims of the association and a first list of supporters, has now been issued in a circular which is abridged below. Though the association had its origin in Cambridge, its activities are, of course, not intended to be limited to Cambridge, but to be national in scope, membership being open to all who have published research or are engaged in research for publication, and associate-membership to all who, without being engaged in research, have its interests at heart. A general meeting will be called in London as soon as possible, to which rules and constitution will be submitted, and at which a governing body and officers will be appointed who will fix the details of organisation. The acting secretary is Mr. A. G. Tansley, F.R.S., Grantchester, Cambridge, to which address applications for membership or for further particulars of the association should be sent.

It is believed that the time is ripe for the formation of a scientific research association to watch over and promote the interests of research in pure science in this country. While applied sceince has recently received a notable stimulus owing to the urgent demands of the war, there is a real danger that the interests of pure science, in spite of recent and very explicit public recognition, may remain neglected. In view of the large projects of reconstruction now occupying the best minds, it seems particularly opportune for men of science to make a concerted effort both to improve the efficiency of their own contribution to national life and to bring home to the mind of the nation the vital importance of science and the scientific method in all departments of national life.

In the first place, it is believed that science requires not only larger endowments, but also more co-ordinated and informed allocation of those endowments than is provided by any existing machinery. It is thought that the best way to construct really adequate machinery is to provide a comprehensive internal system of intelligence as to the research that is actually being done in the various branches of science and of new research as it is projected. Such a system would serve a double function. It would increase the use of existing facilities by putting qualified workers into touch with institutions where the most satisfactory conditions for carrying out their researches already exist, and reciprocally by suggesting to institutions and departments the names of suitable workers. It would also quickly bring to light the deficiencies in existing facilities and enable suggestions to be made for their improvement and increase. Work of this kind is, of course, already done privately and by various bodies, but it is more or less sporadic, casual, and unco-ordinated. It is believed that systematic organisation of such intelligence work would be of great value in facilitating and stimulating the carrying out of research.

It is also believed that the best—indeed, the only completely efficient—method of creating the machinery required is to associate together the whole body of men of science on a democratic basis. It is only by such association that really full information can be obtained and impartially sifted.

The governing body of the association would serve as a link between the proposed intelligence organisation and the Government Departments and other public bodies controlling funds available for the endowment of research, acting as an organ of intelligence as to the funds required. There have already been created, under the auspices of the Department of Scientific and Industrial Research, a number of industrial research associations which will keep the Department informed of the needs and progress of industrial research, as well as themselves carrying on research. Making allowance for the difference of conditions, the Scientific Research Association would aim at performing a somewhat similar function in regard to research in pure science, though it would not, of course, itself undertake research.

The association would necessarily acquire a unique body of information as to the existing situation in regard to research, and would thus be in an exceptionally favourable position for suggesting new and promising lines of development. A conspicuous feature of much recent research has been the development of co-operation, not only between different workers in the same branch of science who undertake joint work on problems beyond the power of single workers to cope with, but also between workers in different departments who co-operate in an attack upon border-line problems which require for their solution the contributions of men trained in more than one branch of science. The comprehensive organisation of the association should render it specially capable of facilitating or even of initiating this kind of fruitful co-operation.

No interference with the work of any existing body is contemplated. The association would act as a co-ordinating agency, and would endeavour to co-operate intimately with existing scientific bodies and to assist all efforts of a similar kind that are at present being made. Thus the Medical Research Committee at present attached to the National Health Insurance Department, in addition to initiating and carrying out research on its own account, also performs similar work in regard to medical research. The Scientific Research Association would hope to co-operate with that Committee in regard to research having a direct or indirect bearing on medical problems, rendering the Committee any assistance that might be possible. It has been suggested that specialist societies representing practically the whole of the research workers in their respective subjects might in some cases be able and willing to carry out the functions contemplated for the subject committees of the association. In such cases, to avoid duplication of organisation, it might perhaps be arranged for the corresponding subject committees to be dispensed with and for the societies in question to have the necessary representation on the association.

But it is felt that the aims of the association should go beyond the better co-ordination of existing work and endowments. There is no doubt that if the national life is to be increasingly vitalised by scientific research and the development of the scientific habit of mind, the ranks of scientific workers must be much more amply reinforced from the best human material. In order to secure such a result it is essential that an assured career should be open to the competent research worker. It is therefore proposed to formulate an extensive scheme of State endowment of research which would afford opportunities for young and promising students to establish themselves in research work and to secure to the ablest of these the opportunity of a career devoted mainly to the continued pursuit of scientific investigation. It is not intended to advocate action which would lead to the separation of research and teaching functions, which are often fruitfully combined in existing circumstances, but rather to secure conditions in which those who are best fitted for research may devote themselves mainly or wholly to research without anxiety.

Finally, it is thought that the association might usefully play a leading part in impressing upon the attention of the public by carefully organised propaganda along definite lines the importance of scientific research in all its aspects, and especially the fundamental value of scientific method in every department of national life and the special claims of pure science to national support.

The proposed organisation and functions include :—

(i) *Information, Intelligence, and Advice.*—(*a*) *Special*, dealing with the needs of and facilities for research in the different branches of science. Organ : *Subject committees* and *secretaries*, intermediary between individuals and institutions. These subject committees and their secretaries would be the most important part of the organisation so far as detailed intelligence work was concerned. They would form a sort of internal nervous system of research in the different subjects, and the threads would be gathered up by the council when it was a question of the need for fresh endowments. The subject committees would not be limited in membership, most of their work being done by correspondence, and would be made really representative of the whole of the research in each subject.

(*b*) *General* intelligence and advisory functions. Organ : *Council, General Purposes Committee, General Secretary*, intermediary between Government and other bodies controlling funds available for research on one hand, and institutions and individuals carrying on research on the other, partly through the agency of the subject committees.

(ii) (*c*) *Propaganda.*—Impressing upon public attention the value and importance of scientific method and scientific research in every department of life. Organ : *Propaganda Committee* and *Propaganda Secretary*.

(iii) (*d*) *Formulation of Scheme of State Endowment of Research.* Organ : *General Purposes Committee* and *Council*.

The proposed working of the organisation here outlined is described in the circular referred to.

SCIENCE AND THE FUTURE.[1]

A MATTER which we now see constantly referred to, in every newspaper and by many public speakers, is what is known as reconstruction—that is to say, the putting of our affairs in order after the finish of the war. Now, undoubtedly the war has been responsible for an enormous amount of destruction of capital; but when estimates are given, as they constantly are given, of the percentage of loss in Belgium, France, Italy, Serbia, and other countries, it is not usually borne in mind that capital does not merely consist of gold and silver, of bricks and mortar, of furniture and fitments, or even of railways, steamships, and machinery—mostly things that in process of time fall into decay—that the main capital of the modern world does not consist of the concrete constructions of labour or of material things at all, but of scientific knowledge. If we could imagine such a catastrophe as destruction on the scale that has recently taken place in the fighting zones spread over the whole civilised world, so that nothing was left anywhere at all of the material handiwork of the past few hundreds of years, this would not necessarily mean the relapse of mankind in general to the savage state of our prehistoric ancestors, who lived before the accumulation of our present priceless scientific knowledge had even begun. That this is so we see clearly from the lessons of the past. For thousands of years the manual labourer has been at work, and untold have been the products of his toil. How many of these products, however, have come down to the present day? Where are now the splendid constructions, the magnificent buildings, the costly and varied manufactures of ancient Babylon, Egypt, Greece, and Rome? A few scattered fragments of a purely antiquarian interest, but of no utilitarian value, are all that are left. The greater portion have entirely disappeared. But not so the products of the ancient mind. These, to a large extent, still endure. For all our industries, all our arts and crafts, and all our sciences have their roots in the distant past. Some knowledge of importance may, in the crash of empires and the great social convulsions that have taken place, have been lost or forgotten, but comparatively not much; while, owing to the invention of printing, and the consequent easy multiplication of records, this is never likely to happen again—at any rate, on a considerable scale.

Thus to reconstruct the material things now temporarily destroyed will take only a very small fraction of the labour that had to be expended, or of the centuries of time that had to pass, while, by slow degrees and arduous effort, man learnt how to bring all these things about. For the mere construction of the material paraphernalia of civilisation is in value as nothing to the knowledge of how to construct them. Taking this into consideration, we recognise the fallacy of the doctrine that all wealth is due to manual labour, and we see how little of the capital of the world is really due to mere handiwork, however skilled, and how much to the mental efforts of exceptional men, who through countless generations, by their investigations, discoveries, and inventions, have rendered possible all our wonderful possessions. When, therefore, we compile estimates of the losses due to the war, let us not forget that our greatest asset, the vast store of knowledge that Science has gathered together for us the heirs of all the ages, is still intact. It is a store that has slowly been accumulating ever since the beginning of the

[1] Abridged from the inaugural address delivered before the Royal Society of Arts on November 20 by the chairman of the council, A. A. Campbell Swinton, F.R.S.

world—a store which enables man more and more to triumph over Nature, and one that for ever remains practically indestructible as the real permanent capital of the race, and by far its most precious heritage.

Now, though the devastation due to the war will in time be readily enough repaired, and this without any call for new scientific invention or discovery, it is otherwise with the general future. Though the doctrine of Malthus—that whilst the population increases in geometrical ratio, the supply of food only increases in arithmetical ratio—is now discredited, the war, in fact, has shown us how nearly the world lives up to its supply of food and other necessaries, and how disturbances, such as those that the war has occasioned, may lead to the disappearance of the little margin there is. Were it not for the aid that Science already affords to agriculture—in mechanical means of cultivation, and in methods of irrigation, fertilisation, and the like, together with facilities as regards transport and countless other matters—neither a country like this nor the whole earth could even now support its present population; whilst in the future, as human beings increase still further, the stress will be accentuated. Whether we are dealing with present-time requirements or with those that are more remote, the shortage of the necessaries of life and of civilisation that is bound to grow in extent, *vis-à-vis* of the increase of the population of the world, can be met only by new achievements in the way of scientific discovery and invention, and by improved and more scientific organisation.

Just as John Stuart Mill feared that the limited number of notes in the audible musical scale would in time lead to the exhaustion of all possible melodies, so there have been those who have thought that scientific discovery would before long come to a stop owing to the dearth of subject-matter and to the limitations of the human intellect. Whatever may be the fact in regard to music, nothing could be more erroneous than this idea in respect to Science, for the reason that every new discovery and invention opens up the path for others, and thus the scientific horizon surely widens year by year. Indeed, so far from discovery and invention being likely to come to a stop, both are sure to extend at a rapidly increasing rate, particularly if we have more science taught to young people and greater encouragement given to scientific workers, with consequent additions to their numbers.

In the comparatively new fields of radio-activity, electro-magnetic radiation, synthetic chemistry, chemical catalysis, electrical osmosis, photo-electricity, and corpuscular matter, to mention at random only a few of those that readily occur to one, the prospect seems practically illimitable. Moreover, new materials with new properties, whether elementary substances such as the new gases—argon, helium, krypton, neon, and others; the so-called rare earths—thorium, cerium, yttrium, scandium, and the rest; or new alloys and compounds which chemists and metallurgists keep providing for particular purposes, afford fresh means for pursuing research. We have also new mechanical appliances of all sorts, and new methods which enable us to obtain, on one hand, in the electric furnace, temperatures approaching in degree to that of the sun, and, on the other, in special refrigerators, to cold quite near to that of space and of the absolute zero—temperatures both high and low, quite beyond reach only a few years ago. Again, we have learnt how to apply prodigious mechanical pressures and how to obtain gaseous vacua on unprecedented scales. We can produce and employ electric currents and pressures, and both electric and magnetic fields, of intensities previously unknown, and measurements of all kinds can be made with a delicacy and an accuracy almost beyond belief.

The number of these things is much greater than there is time to record here, and their importance is intensified by the fact that each reacts on the others with the production of more, so that the tools and agents at the disposal of research are continually being added to. Nor, if we turn from pure science and its possibilities and means for discovery to inventions and the science that is applied to utilitarian uses, is the case in any wise different. Here, again, the effects are cumulative, both discovery and invention assisting to bring still further invention within our reach. The petrol engine, originally invented for propelling boats, and later adapted to driving land vehicles, has rendered possible the conquest of the air by the aeroplane, as also the depths of the sea by the deadly submarine. Bell's telephone, that instrument of almost sublime simplicity, which, as originally produced, was intended for transmitting speech, is now used for receiving the inarticulate signals of wireless telegraphy, which could scarcely have reached its present development without it.

Photography and its sensitive plates and papers are now applied in radiography and in other directions of which the original photographic inventors never dreamed. The metal cerium, first brought into notice by its being a necessary constituent of incandescent gas mantles, now in pocket-lighters helps the smoker in these difficult times to dispense with matches. The vacuum jacket, invented by Sir James Dewar for keeping liquid air cold, is used to-day for keeping things hot. Radium, which when discovered by Mme. Curie was only a scientific curiosity, has many applications in medicine, and is now used to illuminate watches and instrument dials so that they can be read in the dark. The gyrostat, which is a development of the child's spinning-top, and used to be merely a scientific toy, is now the foundation of a description of ship's compass which points to the true, and not to the magnetic, north pole of the earth, and without which the navigation of submarines would be almost impossible. Tungsten, which a few years ago was unknown in true metallic form, now constitutes the filaments of all our incandescent electric lamps; while the discoveries of Crookes, J. J. Thomson, and others in connection with rarefied gases have rendered possible the so-called half-watt lamp of surprising efficiency. By an electric process as old as the time of Cavendish, who discovered it, nitrogen from the air is now being extracted to make nitrates so necessary for agricultural fertilisers and for explosives, which latter have their uses apart from their application to warfare. The kinematograph of the modern picture palace has been developed out of the old Wheel of Life of the days of our childhood. Indeed, the list that could be compiled is almost endless.

One of the most interesting of modern inventions is that of wireless telegraphy, and it is also one which appears to present great scope for improvement and extension. There is a mysterious fascination that captivates the imagination about these wireless signals, which come over hundreds and thousands of miles of space without any visible or tangible means of connection. Yet, as a matter of fact, they are in nowise more wonderful than telegraphy by wire. Indeed, had, as might quite have been possible, the wireless method been the first to be discovered, then our wonder would have been excited at the ease with which, by means of a wire of minute section, the signals could so easily be conveyed over prodigious distances in any direction to any required point. For the wireless system is really analogous to the uproarious fog-horn, the signals of which are sent out far and wide in all directions, for all who have ears, and are within range of the sound, to hear; while wire telegraphy more resembles the speaking-tube, whereby much smaller sounds are conveyed from the speaker to a particular listener at the other end.

Now during the past five years the improvements made in wireless telegraphy, and also in wireless telephony, have been very important, but as yet it is not admissible to discuss them; besides, my subject is rather the future than the past. One matter, however, is within public knowledge, and that is the increased and still increasing amount of news that we get in the papers that appears under the heading of "Per Wireless Press." Indeed, wireless telegraphy appears to be developing at last in what has always appeared to me to be its proper field, which is not so much to communicate between one individual and another as for the communication of intelligence broadcast over the earth, *urbi et orbi*—to the city and to the world—to borrow from the famous wording of the Papal benediction from the Loggia of St. Peter's in Rome of bygone times. No doubt maritime wireless communication between ships, and between ship and shore, hitherto its most useful application, is another case altogether, and supplies a want that telegraphy by wire cannot meet at all. With this we are already familiar, while the use of wireless as a voice that can speak simultaneously to points on every portion of the earth is in some ways a more novel proposition.

No doubt some persons who had private wireless stations of their own before the war used to get time-signals from Paris from the Eiffel Tower, and from Nauen in Germany; while a few of those who had mastered the difficulties of reading the Morse alphabet by ear were able to decipher weather reports from these places, as well as from our own Admiralty, in addition to general news from Poldhu, in Cornwall, and from one or two other large stations.

What I have in my mind, however, goes much farther than this. In London tape- and column-printing telegraph instruments operated by wire, that record sporting, Parliamentary, and general news, have long been familiar objects in clubs and hotels, and become a portion of our daily life. Now there is no reason at all why similar printing instruments, which he who runs may read, should not be operated by wireless means, not only in London and other large cities, but also throughout the country, or even throughout the world. Special transmitting stations using different wave-lengths could send out the messages, while separate printing machines, tuned each to respond to the wave-length of a particular transmitter, at each required point, would receive and record them. No connecting wires, costly as regards both first expense and upkeep, would be required, but only suitable aerials at each transmitting and receiving station.

Some regulations would be necessary to prevent interference, and as wireless waves, travelling as they do through the ether of space at the enormous speed of 186,000 miles per second, recognise no international boundaries, they would have to be universal. Thus arises a fitting opportunity for the League of Nations. For the distribution of news to the Press nothing could be better or more economical, while there is no reason why clubs, hotels, and private houses everywhere should not also be thus supplied with the latest intelligence. For in wireless telegraphy it costs no more to send signals to a thousand receiving stations than to a single one, and there is practically no limit to the number of the stations that can simultaneously receive signals from a single transmitting station. To some this sketch of the universal distribution of news to all and sundry may appear fantastic, but it is not really so at all; for, at any rate as concerns an area no larger than Western Europe and the British Isles, it is well within the range of practicability at the present time, and only requires a little working out to arrive at the best arrangements. Nor is this all; spoken words of the human voice have already been intelligibly transmitted by wireless across the Atlantic between the United States and Paris—a feat that has never been accomplished by cable; and there is no reason that I am aware of why, in the near future, we should not have a public speaker, say in London, in New York, or anywhere, addressing by word of mouth and articulate wireless telephony an audience of thousands scattered, maybe, over half the globe.

Great things are at present being foretold as to the marvels that we are to see in the way of the electric distribution of energy throughout the whole country from a small number of giant generating stations. Indeed, the subject is considered of sufficient importance to be mentioned in the Prime Minister's election address, which in itself is surely a sign of the times. The hope is held out that electric energy is thus to be so cheap that it will supersede every other kind of energy, not only for driving our mills, our machinery, and our railway trains, but also universally for cooking, heating, and other domestic purposes. Great improvement over our present parochial methods—according to which Parliament, in its wisdom, has divided up the country into an enormous number of absurdly small municipal electrical areas, which are far too limited in consumption for any reasonable economy to be obtained—is no doubt possible, but let us not be too sanguine. Some of the highest and most experienced authorities are of the opinion that the limits of economical generation and distribution are already being reached in the case of some of our larger systems, and that when we get above tens of thousands of horse-power the step to hundreds of thousands does not effect more than a small percentage of saving, either in first cost or in cost of working.

There is also the question of material for the distribution conductors. Excepting silver, which, of course, is out of the question, pure copper, which is almost as good as silver, is the best electrical conductor we know of, and the amount of copper in the world is, of course, limited. No doubt by raising the electrical pressure, the amount of energy conveyed through a given conductor with a given loss can be largely increased. But, again, there are limits to the endurance of insulating materials that can be obtained at a reasonable cost, though perhaps there is more obvious scope in regard to this than as regards increasing the conductivity of conductors. In a recent speculative article of American origin by Dr. J. A. L. Woddell, I notice that the writer prophesies the discovery of an alloy of ten times the conductivity of copper, but, so far as we at present know, all alloys have a worse, and not a better, conductivity than their elementary constituents; and though, so far as I am aware, no special investigation has ever proved that this is a natural law that cannot be overcome, still, conversely, there are no data to show that improvement can be looked for in this direction. True, Dr. H. Kamerlingh Onnes, of Leyden, not long ago showed that, by reducing the temperature of metals to the temperature of liquid helium, or to within less than 4° of the absolute zero of temperature, or more than 450° below zero Fahrenheit, these lose practically all resistance, and become nearly perfect conductors. Under these conditions an electric current, once started by an electromotive force applied to a cooled mercury ring, was found to persist for hours after the electromotive force had been removed

—truly a startling effect, and one calling to mind Ampère's theory of permanent magnetism, according to which the magnetism is supposed to be due to molecular electric currents that persist indefinitely.

Still, even to those most anxious to do their best to believe in the wonders of the future, the cooling of electrical conductors by passing through them streams of liquid helium, in the case of the thousands of miles of such conductors that are requisite for electrical distribution, does not appear to be a very practicable proposition. However, results like those obtained by Onnes give one furiously to think, and there are other solutions that are possible, though at present far from within our grasp. For instance, no one knows what improvement is yet to be obtained in the conductivity of metals by further purification, and especially by freeing them entirely from occluded gases. Electrolytic copper, which is specially pure, has already a conductivity measurably in excess of what was obtainable by the older methods of refining, while it has been found that in the case of palladium the extraction of the occluded hydrogen materially improves the conductivity. Possibly similar treatment might lead to important results with other metals. The subject is still largely unexplored, but if any practical method could be devised for diminishing the resistance of conductors, it would be a most important matter, as the enormous amount of copper at present required for any very large and widespread scheme of electrical distribution presents a very real difficulty.

It would also be rash to deny too positively the possibility of the wireless transmission of electric energy in bulk. The fact that enormous quantities of energy come to us in this way from the sun, with a transmission density that near the sun's surface is immense, shows what the ether is capable of doing. The production of plane waves would help the solution of the problem, but there is the difficulty of so concentrating and directing the waves that they may all be received on a limited area. Perhaps, however, it may be found that though electromagnetic waves cannot be driven to go exactly and only where wished, they can possibly be led there. It is a problem at present beyond our ken, but so many marvels come to pass that one can never be sure of what may be brought about, provided always that no natural law stands in the way.

When coal is exhausted it would seem that in the main recourse will have to be had to the enormous flood of solar radiant energy that is continually falling on the earth, and the problem is how this can best be utilised. The most obvious method is, of course, to grow plants, stimulating them in every way that science can devise, and cultivating especially those which grow most rapidly and are specially suitable for the production of fuel. Such fuel need not, however, take the crude form of mere firewood, but more likely it will be best to cultivate plants that store the solar energy in the form of starch and sugar which can be converted into alcohol, as is already being done on some scale in order to supplement petrol for motive purposes.

As, however, vegetation is an exceedingly inefficient accumulator for the storage of solar energy, and as there is the further inefficiency of the heat engine to be taken into account before mechanical power can be realised, there arises the question whether science cannot devise some more efficient and different method of converting solar radiation into work, leaving altogether on one side the organic world and the means that plant-life affords. Solar engines, in which the heat of the sun's concentrated rays in tropical climates is employed to boil water or other more volatile liquids, and thus operate steam-engines, are by no means new, but owing to their considerable first cost per horse-power and their great cost of upkeep, they have never so far proved commercially practicable, even where coal is exceedingly dear. They also suffer in an extreme degree from the limitations of all heat-engines, inasmuch as they cannot take proper advantage of the extremely high temperature of the sun, but have to work at a much lower temperature, which implies degradation of the energy and loss.

Happily, solar-heat engines do not exhaust the possibilities of the case, as there remain other methods which, though still in the womb of the future as regards development, can yet be indicated, and with regard to the success of which there is no inherent improbability. Photo-chemistry is usually associated with the art of photography, but really embraces a much wider field, the potentialities of which have as yet been but very imperfectly explored. The direct transformation of radiant energy into chemical, or even into electrical, energy is by no means impossible; indeed, the former transformation is already effected, inefficiently it is true, by plants; while it also takes place on a small scale in all photographic processes where light causes chemical reduction. Becquerel, in France, showed some fifty years ago how radiant energy could be transformed into electrical energy; and Minchin, in England, and others have also done the same by different methods. There do not appear to be any theoretical objections to success, nor to much higher efficiencies being obtained in this way than by organic means. No doubt the laws of thermodynamics apply to all photo-chemical action, but as the temperature of solar radiation is so very great this is of no large importance. Here, then, in photo-chemistry, perhaps in photo-electric chemistry, we have probably the most important problem that the science of the future has yet to solve.

Of late, in the world-war, on many a stricken field, our own and our Allies' armies have been overcoming our adversaries and subjugating the power of evil. In the future may we hope for conquest in even a wider realm? From now let us look forward to the further triumph of Science over the forces of Nature, and to the bringing of these forces still more into subjection for the common service of mankind, for—

> Peace hath her victories
> No less renowned than war.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Academic Council reported to the Senate of the University on November 20 the resignation by Sir Herbert Jackson, in view of his appointment as director of the British Scientific Instrument Research Association, of the Daniell professorship of chemistry attached to King's College. Sir Herbert Jackson has held this office since 1914, having been first appointed to the staff of the college in 1887, and having occupied the chair of organic chemistry since 1905. The Senate has conferred upon him the title of emeritus professor of chemistry in the University of London, and appointed as his successor in the Daniell chair Lt.-Col. A. W. Crossley, who has since 1914 held another professorship of chemistry in the college.

The University has recently revised the regulations for the admission of graduates of other universities as candidates for its higher degrees except in medicine and surgery. Since its reorganisation in 1900 about 350 graduates of other universities in all parts of the world have been so admitted. In the course of last year an appeal was addressed to the universities of the United Kingdom on behalf of the Canadian universities asking (1) for the establishment of a doctoral degree the qualifications for which take account of preliminary work done in Canada for lower degrees, the standard of the degree to be such as to bring it within the reach of the best Canadian students who hold the preliminary Canadian degree; (2) for the time to be spent in the United Kingdom not to exceed three years; and (3) for the provision by the British universities of a certain number of scholarships open particularly to students from the Overseas Dominions. With respect to the first request, the University of London has always regarded the work done by a graduate of another university as the foundation of his claim for admission. A candidate so admitted stands on the same footing as an English candidate, and should have an equal chance of obtaining a doctoral degree. Arrangements have been made for informing Overseas students before leaving their homes whether they can be admitted. The second request is met by the regulations under which, out of the four or five years which must elapse between the date of the examination which forms the basis of admission and that of the examination for the doctoral degree, only two need be spent in London. The third request can be complied with if sufficient financial support is provided by the Parliaments of the Empire and the Overseas Dominions.

OXFORD.—Sir Basil Zaharoff has intimated to the Vice-Chancellor his desire to offer to the University the sum of 25,000*l.* "for the establishment of a chair of French, to be called the Marshal Foch professorship of French literature, and for other purposes connected with the promotion of French studies."

THE sum of 20,000*l.* has been offered to the George Watson's College, Edinburgh, by Mr. James Glass, of London, in aid of the establishment of a school of chemistry at that institution.

THE title of emeritus professor of experimental philosophy has been conferred upon Dr. E. H. Griffiths, F.R.S., on his retirement from the principalship of the University College of South Wales and Monmouthshire.

THE course of twelve Swiney lectures on geology for 1918–19 will be delivered at the Royal Society of Arts, beginning on December 10, by Dr. T. J. Jehu, who will take as his subject "Man and his Ancestry." The lectures will be given at 5.30 o'clock, and admission will be free.

THE Elgar scholarship in naval architecture, which is of the annual value of 100*l.* and tenable for three years, will be offered for competition in 1919 among students of the Institution of Naval Architects. Communications respecting the scholarship should be sent to the Secretary of the institution, 5 Adelphi Terrace, W.C.2.

APPLICATIONS are invited by the Salters' Institute of Industrial Chemistry for a limited number of fellowships, value from 250*l.* to 300*l.* per annum, to be awarded for post-graduate study in the methods of chemical research, or in any branch of chemistry bearing on industry, including chemical engineering, to young chemists who have completed a degree course at a recognised college or university, and whose training has been interrupted by naval, military, or national service. Applications, with references and full particulars of training and experience, should be sent to the Director of the Salters' Institute, Salters' Hall, St. Swithin's Lane, E.C.4.

ON Saturday last, November 23, the Chancellor of the Exchequer, the President of the Board of Education, and the Secretary for Scotland received a deputation of representatives of all the universities of the United Kingdom and of certain other institutions doing work of university standard. The Irish Chief Secretary was, at the last moment, prevented from being present. Oxford and Cambridge took part in the deputation, not as suppliants, but for the sake of showing the solidarity of the universities in their plea that higher education does not at present receive the degree of support from the State which is essential if the educational fabric is to be complete and the brains of the nation are to be adequately trained for the service of the State. The deputation was introduced by Sir Donald MacAlister, K.C.B., Vice-Chancellor and Principal of the University of Glasgow. The case for the universities of England and Wales was presented by Sir Oliver Lodge, that for the Scottish universities by Sir Donald MacAlister, and that for the Irish universities by Sir Bertram Windle. Sir Alfred Ewing spoke of the need for a capital fund available for buildings and equipment. The claims of the "humanities" were advocated by Sir George Adam Smith, those of science by Prof. W. H. Bragg, those of medicine by Sir Bertrand Dawson, and those of commerce and economics by Sir William Ashley. Sir Alfred Dale, Sir Gregory Foster, and Prof. Gillespie also spoke. The Chancellor of the Exchequer and the President of the Board of Education made sympathetic replies.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, November 20.—Sir Napier Shaw, president, in the chair.—Prof. R. DeC. **Ward**: The larger relations of climate and crops in the United States. For the purpose of his inquiry Prof. Ward divides the States into two major divisions separated by the mean annual rainfall line of 20 in., which forms the eastern boundary of the Great Plains. These are again divided into agricultural districts or belts as a framework into which the larger facts of climate and crop distribution and of types of farming are fitted. The eastern half of the country has sufficient rain in normal years, and ordinary farming methods are followed. The western half, with generally inadequate rainfall, is a region of irrigation, of dry farming, and of grazing. Here there are no great belts distinguished by certain dominant crops as in the east; the crops are very varied, often extremely localised. The crops in both divisions are discussed with much detail as to the influence of climatic factors. A comprehensive bibliography is appended.—Capt. C. J. P. **Cave** and J. S. **Dines**: Soundings with pilot balloons in the Isles of Scilly, November and December, 1911. The ascents were made to ascertain the wind structure in a place where the effect of land masses may be regarded as at a minimum. The Scilly Isles consist of a small group of islands twenty-five miles south-west of Land's End. The greatest height above sea-level does not much exceed 150 ft. The period covered by the observations (November 22 to December 8) marked the setting in of a south-westerly type of pressure distribution, with low pressure over Iceland. This type became well developed by November 30, and during the rest of the period several pronounced secondaries passed across the British Isles from the Atlantic. The ascents show that the changes in wind associated with the passage of these secondaries were more marked near the surface than at greater heights. Taking the mean of the ascents, the layer in which surface friction made itself felt on the wind velocity was decidedly shallower than at inland stations. The majority of the balloons were followed with two theodolites and the vertical motion computed. The average rate of ascent is found to agree closely with the value given by the formula now generally adopted in this country. There was little change in the mean rate between the ground and 4 km. height. In this particular the results differ from those obtained at inland stations, where the rate of rising has been found generally to be greater in the first half-kilometre than at greater heights.

PARIS.

Academy of Sciences, October 28.—M. P. Painlevé in the chair.—The permanent secretary read a letter signed by MM. H. Parenty, Laguesse, Duret, Witz, and A. Calmette, members and correspondants of the Institute, of the Academy of Medicine, and of the Academy of Agriculture, retained at Lille during the German occupation, giving an account of some of the outrages and indignities inflicted by the German authorities upon the population.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: Injections of blood plasma (plasmo-therapy) for replacing blood. It has been shown in previous communications that dogs after heavy loss of blood (54 grams of blood per kilogram of body-weight) only survive if a transfusion of blood or blood plasma is made. In the present paper experiments are given showing that the blood corpuscles play only a secondary part, the efficacity of the transfusion being mainly due to the plasma.—G. **Giraud**: The connection with the theory of hyperabelian functions of a certain partial differential equation of the second order, with a generalisation to any number of variables.—A. **Angelesco**: The simultaneous approximation of several definite integrals.—M. **Riquier**: A property of analytical functions with any number of imaginary variables.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the first quarter of 1918. Details of observations made on seventy-six days during the quarter.—A. **Véronnet**: The limit and composition of the terrestrial atmosphere. Aurora borealis, meteorites, shooting stars. The percentage of nitrogen increases regularly at altitudes up to 100 kilometres. Between 100 and 150 kilometres the nitrogen forms 96 per cent. of the atmosphere at a pressure below 10^{-6} atmosphere, a pressure of the same order as that in a Crookes tube. This is the region of the aurora borealis.—J. **Renaud**: The deep ports on our Mediterranean coast and on those of our colonies and protectorates.—E. **Carvallo**: The correction of faults in lenses.—Albert and Alexandre **Mary**: The inversion of cane-sugar by colloidal silica. Colloidal silica effects an appreciable inversion of cane-sugar, and its inverting power is a function of its state of dispersion.—H. **Hubert**: Limit of the horizontal siliceous grit in western Africa.—J. **Chaine**: Contribution to the phylogeny of muscles.—M. **Baudouin**: The discovery of a trustworthy method for recognising sex in human vertebræ of any age.—M. **Folley**: The action of sodium citrate on the blood. · Ch. J. **Gravier**: The Actinia from great Atlantic depths obtained during the cruises of the *Princesse-Alice*, and some biological characteristics of these animals.

BOOKS RECEIVED.

Cast Iron in the Light of Recent Research. By Dr. W. H. Hatfield. Second edition. Pp. xvii+292. (London: C. Griffin and Co., Ltd.) 12*s.* 6*d.* net.

The Principal Species of Birds Protected by Law in Egypt. By Capt. S. S. Flower and M. J. Nicoll. Pp. iv+8+viii plates. (Cairo: Government Press.) P.T.5.

A Modern Pilgrim in Mecca. By A. J. B. Wavell. New cheaper impression. Pp. xv+232. (London: Constable and Co., Ltd.) 2*s.* 6*d.* net.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. vii., part 1: England and Wales. By Dr. A. Strahan and J. Pringle. (London: H.M.S.O.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 4.30.—Bhupendranath Basu: Some Aspects of Hindu Life.

MONDAY, DECEMBER 2.

ARISTOTELIAN SOCIETY, at 8.—Principal F. B. Jevons: Rabindranath Tagore's Personality.

ROYAL SOCIETY OF ARTS, at 5.—Prof. J. C. Philip: Physical Chemistry and its Bearing on the Chemical and Allied Industries.

SOCIETY OF ENGINEERS, at 5.30.—H. Kelway-Bamber: Notes on Railway High Capacity Wagons' Wheel Axles.

TUESDAY, DECEMBER 3.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Continued Discussion*: R. B. Joyner: The Tata Hydro-electric Power-supply Works, Bombay.—*Followed by* E. L. Leeming: Road-corrugation.—F. Wood: Investigations in the Structure of Road-surfaces.—T. B. Bower: Notes on Road Construction and Maintenance.

RÖNTGEN SOCIETY (at King's College Hospital, Denmark Hill, S.E.), at 7.30.—Visit to the Radiographic and Electro-therapeutic Department. Demonstrations of Apparatus.

WEDNESDAY, DECEMBER 4.

ENTOMOLOGICAL SOCIETY, at 8.—Dr. H. Eltringham: Butterfly Vision.

GEOLOGICAL SOCIETY, at 5.30.—Wheelton Hind and A. Wilmore: The Carboniferous Succession of the Clitheroe Province.

ROYAL SOCIETY OF ARTS, at 4.30.—B. Seebohm Rowntree: Housing after the War.

SOCIETY OF PUBLIC ANALYSTS, at 5.—Dr. Eric K. Rideal and Dr. H. S. Taylor: Recorder for Estimating Carbon Monoxide in Inflammable Gases.—A. D. Powell: The Estimation of Phenacetin and other Para-aminophenol Derivatives by Hypochlorous Acid.—H. E. Annett and Hardayal Singh: Effect of Morphine Concentration on the B.P. Method of Morphine Estimation.

THURSDAY, DECEMBER 5.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. Miles Walker: The Supply of Single-phase Power from Three-phase Systems.

LINNEAN SOCIETY, at 5.—Prof. W. A. Haswell: A Revision of the Exogonidæ.—C. D. Soar: Exhibition of Coloured Drawings of British Mites.—The General Secretary: The Tulbagh-Linné Correspondence.

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

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THURSDAY, DECEMBER 5, 1918.

BRITISH SANDS.

(1) *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 Analyses by Dr. H. F. Harwood and A. A. Eldridge. Second edition. Pp. xi+183. (London: Longmans, Green, and Co., 1918.) Price 7s. 6d. net.

(2) *A Memoir on British Resources of Refractory Sands for Furnace and Foundry Purposes.* Part i. By Prof. P. G. H. Boswell. With Chemical Analyses by Dr. H. F. Harwood and A. A. Eldridge. Pp. xii+246. (London: Taylor and Francis, 1918.) Price 8s. 6d. net.

IN pre-war days large quantities of Continental sands were used in both the metallurgical and glass industries, the low prices at which they were delivered at our seaboard being mainly due to their transport as ballast in returning coal-boats. Quite early in the war the stocks of these sands were exhausted, and it had become a matter of urgency to replace them by home supplies. Owing to the difficulties of transport, it was essential that, wherever possible, deposits of sand easily accessible to the industrial centres should be utilised. Much of the success which has attended the efforts to utilise our home resources of sand is unquestionably due to the survey made of them by Prof. Boswell at the instruction of the Ministry of Munitions, and in its earlier stages under the auspices of the Imperial College of Science and Technology. The author's contention that many sands were unnecessarily imported, and others equally unnecessarily moved about the country, cannot be gainsaid, and in view of the industrial importance of sands it is remarkable that hitherto there has been little or no systematic investigation of our native resources of them.

(1) The rapid exhaustion of the editions of the author's two earlier memoirs on our native resources of sands suitable for glass manufacture is an indication of the appreciation they received from the glass industry. Prof. Boswell has rendered further service by gathering into one volume the results of his investigation, and it is unquestionably the most important contribution which has been made to our knowledge of the sands of this country. The rapid and efficient manner in which the large amount of work entailed has been carried through and presented for use has been no inconsiderable factor in enabling glass manufacturers to replace by home supplies the imported sands previously used. It is not too much to say that one result of these investigations will be that imported sands will no longer be used except for the highest qualities of glass, and even for these there is a possibility of the sand from Muckish Mountain, Co. Donegal, proving suitable, although its inaccessibility may be a bar to its use.

In discussing in detail the methods for the mechanical analysis and grading of sands, the author points out the advantage of elutriation processes over sifting or screening, and describes a single-vessel elutriator of simple construction. The mechanical composition of a large number of sands is represented graphically, a method which brings out many useful points. Attention is directed to the value of aluminiferous sands, and it is unfortunate that the majority of our native sands carrying a high proportion of alumina are also high in iron, and therefore useless for all but the commonest varieties of bottle glass. A chapter is devoted to the methods in use for the improvement of sands by special treatment, and it is of considerable interest to note that sand-owners are now giving increased attention to this important matter. For purposes of comparison notes are given of a number of largely used Continental and American sands. Useful sketch-maps are appended showing the outcrops of the geological formations in which glass sands occur, and the location of the chief British resources in relation to the glass-making areas.

The author is to be unreservedly congratulated on a piece of work of the utmost value to our rapidly reviving glass industry.

(2) The memoir on British resources of sands suitable for furnace and foundry purposes will be invaluable to the iron and steel industries, as it for the first time places on record the information necessary to enable manufacturers to select sands for trial and subsequent utilisation. The purely scientific investigation of these materials must come first, but the ultimate tests must be in the works themselves, and investigations of the type of the present memoir will do much to link up the work of the man of science with that of the manufacturers.

The author's lines of laboratory work comprise chemical analysis of the bulk sand and its individual grades, mineral analysis, and mechanical analysis; and, again, many important points are brought out by the excellent graphical method of expressing the results of the mechanical analyses. In dealing with moulding sands the author adopts the plan of exhaustively examining a sand which works experience has shown to be highly suitable, and by deduction from the laboratory results noting what appear to be the desirable qualities. The special feature of a good moulding sand is its property of absorbing water without becoming really wet, and further investigation of this water-holding capacity is desirable because of its important bearing on the "bonding" qualities of the sand. It will be readily gathered from a perusal of this memoir that we have still much to learn respecting the properties of sands, and there is room for much interesting research work in connection with both naturally bonded sands and synthetic moulding sands made by admixing a high silica sand with clays and other bonding materials. There is much valuable empirical knowledge in the hands of foundry foremen which requires translating to a scientific basis.

To avoid delay in making the results of the survey available, the present part i. of the memoir deals mainly with the extent and character of our chief resources available. The author can be assured a particular welcome for part ii., dealing with further resources, and discussing the results of other important laboratory and works tests.

The sketch-maps are of interest, but in the chief of them, showing the location of the main British resources of refractory sands in relation to the metallurgical areas, it may be pointed out that such important iron-producing areas as the West Coast of Scotland, Frodingham, Workington, and Brymbo have been omitted. W. J. R.

GOADS FOR THE PHYSICS TEACHER.

A Calendar of Leading Experiments. By William S. Franklin and Barry Macnutt. Pp. viii+210. (South Bethlehem, Pa.: Franklin, Macnutt, and Charles, 1918.) Price 2.50 dollars.

Readers of Prof. Franklin's book, "Bill's School and Mine," will open the present volume with zest, and their anticipation of enjoyment will be increased by the remark on the title-page: "The authors are teachers, and they consider teaching to be the greatest of fun; but they never yet have been helped in their work by anything they have ever read concerning their profession." Bacon mentioned a "calendar of leading experiments for the better interpretation of Nature" as one of the things most needful for the advancement of learning, and it would seem that the authors, having failed to find assistance with regard to physical lecture demonstrations, have boldly set about filling the gap. Perhaps this method of statement is a little unfair to the excellent volume published under the auspices of the French Physical Society! The authors state that their book has to do primarily with class-room experiments in physics; secondarily it is intended to set forth the possibilities of an extended course in elementary dynamics, including the dynamics of wave motion. The writer is of opinion that most teachers will find the most stimulating part of the volume to be the humorous interludes, criticisms, and questions with which the book is filled from beginning to end. "So many things in teaching *are* funny, from our point of view." "Precision of thought is not dependent upon precision of measurement." "Science, even in its elements, presents serious difficulties." The following problem was given to a group of engineering students:—"A cart moves due northwards at a velocity of $5\frac{1}{2}$ ft. per sec. A man pushes vertically downwards on the cart with a force of 200 lb., and a mule pulls due northwards on the cart with a force of 50 lb. Find the rate at which the man does work, and the rate at which the mule does work." In answer to the question 44 per cent. of the young men found that the man developed 2 h.p. and the mule developed $\frac{1}{2}$ h.p. "Truly, mule-driving would be strenuous labour for our pampered college students!"

Prof. Franklin is a formidable controversialist, but one statement by the authors is certainly open to question. "It is conceivable that the atomic conceptions of electrical phenomena may some time come to be important in everyday life and in everyday engineering, but that time is certainly not yet" (p. 117). Putting aside Faraday's laws of electrolysis, the Coolidge tube and the thermionic appliances used in wireless telegraphy can scarcely be ignored at the present time.

To the experiments described it is impossible to refer at length; some are old, many are new. "The best experiments are those that are homely and simple, and suggestive rather than informing. The physics lecturer should pull ideas out of things like a prestidigitateur." The authors suggest that colleges and technical schools should have fully equipped "Visitors' Laboratories of Physics," and every member of the department, including Clarence and Pete, may take a share of the fun of edifying visitors. "The entire equipment need cost no more than four or five thousand dollars." Let our millionaires please note!

A book for physics teachers to read and ponder over. H. S. Allen.

APPLIED ANALYTICAL CHEMISTRY.

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, 1918.) Price 25*s.* net.

It is pleasant to have in English a work like the present, emanating from Italian chemists. Such a book would be welcome at any time, but is especially so just now, when Italy is allied with us against a foe who has grossly misused his knowledge of chemical science.

Prof. Villavecchia's treatise deals with the analysis of foodstuffs and the principal industrial products, including, therefore, both organic and inorganic substances. As regards general scope and design, the book is of an intermediate character: it is not a mere summary, but neither is it so comprehensive as works like those of Allen or Post and Neumann. It does not, for example, treat of alkaloids, drugs, or pharmaceutical chemicals.

The present volume (ii.) is chiefly concerned with organic products. About one-half of the matter is devoted to foodstuffs, and the remainder to various industrial commodities, including essential oils, varnishes, rubber, tanning materials, inks, leather, colouring matters, and textile articles.

A very good selection of modern analytical methods has been made. The directions for carrying them out are clear and concise. Difficulties are pointed out, and the limitations of particular processes indicated. Methods are not merely outlined, but reasonably full descriptions are given, allowing of determinations being made with the requisite certainty and precision by any competent operator.

On looking through the various sections one finds little to criticise, and much that leaves a favourable impression. Sugar analysis, for example, which is often treated much too scantily in general treatises, receives adequate attention in the work under review. This chapter, in fact, is excellent, and one of the best in the book. The section on milk is quite good generally, but for use in this country it would have been improved by including the standard requirements and adapting it to English practice, much in the same way as the chapter on beer has been treated. Of the other sections, those on spirituous liquors, colouring matters, and textile articles may be singled out for commendation. The Allen-Marquardt method of determining higher alcohols, however, is not included in the first-mentioned group; presumably it is not in favour with Italian chemists.

Occasional references are given, but more might well be included, for the benefit of readers who may wish to consult the original descriptions. For example, both the Denigès colorimetric and Thorpe and Holmes's gravimetric method of estimating methyl alcohol are described, but without reference either to the authors or to the original papers.

These omissions, however, are minor matters. The work, as a whole, will be found useful and practical; it well deserves a place in the analyst's library. A meed of praise is certainly due to the translator, who has done his work very well indeed. C. SIMMONDS.

OUR BOOKSHELF.

Contouring and Map-reading. By B. C. Wallis. Pp. 48. Price 2s.

Macmillan's Geographical Exercise Books: VII.—Physical Geography. With Questions. By B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd., n.d.) Price 1s. 6d.

THESE books, which form parts of a series by the same author, have the advantage of being compiled by a teacher of wide experience who has given much thought to the presentment and mapping of geographical data. Mr. Wallis has shown considerable ingenuity in devising some of his exercises, and to a great degree has managed to avoid the trivial and merely mechanical tasks which often make such work irksome and of little value. In the volume on contouring and map-reading, which is specially to be recommended, advantage has been taken of the interest the war has given to geographical study in making use of many excellent war-maps in setting questions. Attention should also be directed to the exercises in making sketches from contour maps, though perhaps the method requires rather more explanation than is offered. In the glossary in the volume on physical geography the definition of barometric gradient requires revision. But the feature that gives the books great value is that every exercise has to be done on an accompanying map or diagram. The maps are clear and well printed, even to the smallest details. These books should give pupils an excellent grounding in the use and construction of maps.

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 Perception of Sound.

I WOULD first thank those correspondents who have replied to my difficulties with respect to certain theories of the function of the cochlea. Unfortunately, the fundamental physical difficulty has not received the consideration that I hoped for, probably because it was not made sufficiently clear. Sir Thomas Wrightson (NATURE, November 7) gives a quotation from Helmholtz which does not seem to me to meet the case, but perhaps it was written in connection with a different aspect of the problem. It is not obvious how the dimensions of the space filled with liquid in relation to the wave-length of the vibrations affect the nature of the process. If it were the case, the conduction of sound in liquids should be of a different nature according to the dimensions of the vessel and the pitch of the note. May I, therefore, put the question in another way?

When sound-waves impinge on water and are conducted through it, there could not be the necessary condensations and rarefactions unless the mass of water in front of the advancing wave offered sufficient resistance by its inertia to enable the local compression to take place. If the column of water moved as a whole in the way assumed by Sir Thomas Wrightson's theory, it could not conduct sound-waves as such, since there would be no possibility for the formation of any local differences of density. Now the impulses impressed by the stapes on the liquid of the cochlea are identical in time-course with sound-waves, and the nature of the disturbances in this liquid must be the same as if it were conducting sound. Of course, the column of liquid moves as a whole to relatively slow rates of incidence of energy. If a short, sharp tap be made on a membrane at one end of a column of water, the ear at the other end does not perceive the sound at the moment at which the blow is given; the transmission is by a wave. If it were necessary that the whole column of water should be moved, a large expenditure of energy would be required. It seems to be assumed that the force available is too small to do anything but move the liquid column in the cochlea as a whole, unequal to effect anything in the nature of a compression. But is this so? The force is concentrated into a very minute space. On the whole, I can see no alternative but the conclusion that the waves to which the organ of Corti responds are the same as sound-waves. I regret that Lord Rayleigh in his letter (NATURE, November 21) has overlooked this point, about which his statement would have carried so much weight. It is important, however, that he does not see so many difficulties in the resonance theory as others do.

I cannot quite follow Sir Thomas Wrightson's explanation how there is produced a difference of pressure between the two sides of the basilar membrane. It seems to assume that there is a wave of pressure—that is, a sound-wave. Although the helicotrema is small, the volume of liquid moved through it is very minute (0·075 cub. mm. as a maximum, p. 96 of Sir Thomas Wrightson's book), and the existence of a difference of mechanical pressure is difficult to believe. The hairlets would not be bent unless there were such a difference.

When Sir Thomas Wrightson states that the strongest argument against the "string instrument theory" is that the basilar membrane does not consist of separate strings, he forgets that this is not an essential part of the resonance theory. Helmholtz made his calculations on the assumption that the membrane is homogeneous, but has a greater tension laterally than longitudinally.

Prof. Keith (NATURE, October 31) has pointed out that the work of Keith Lucas and Adrian on the "all-or-nothing" character of the nerve impulse was done on motor nerves only. I am obliged to him for doing so, and apologise for omitting to mention the fact. At the same time, we know of no such differences in the properties of motor and sensory nerves as to suggest a fundamental contrast of the kind required. There seems no inherent difficulty in the performance of similar experiments on sensory fibres, using the reflex as an indicator. Perhaps Dr. Adrian, when freed from his military duties, may find it possible to undertake the work. The results would be of great value.

I admit that the title of Sir Thomas Wrightson's book implies that the internal ear has analytical functions, but it is not easy to see what these are on his theory. In fact, Prof. Keith states on p. 159 of the book that the relegation of the powers of analysis to the cerebral cortex is the hypothesis advanced by Sir Thomas Wrightson.

With regard to the necessary function of all structures found in an organism, I think Prof. Keith must have misunderstood my words; for he would scarcely claim a functional importance for the details of such structures as the splint-bones of the modern horse. It is to be remembered that Helmholtz did not profess to account for the whole of the mechanism of the internal ear. He would no doubt have been the first to recognise the necessity for modifications and additions to his theory. When we find a particular mode of effecting a given object in living organisms, it by no means follows that this is the simplest or best conceivable. Structures already present, of ancestral origin, are taken into use.

As Lord Rayleigh points out, the crux of the matter is the applicability of Müller's law. The parallel between sound and light is not so much that between the perception of pitch and colour as the perception of the elements of an image on the retina, each of which must be transmitted by its own special nerve-fibre. This circumstance, together with Lord Rayleigh's difficulty of admitting the capacity of nerves to transmit 10,000 vibrations per second and that of the "all-or-nothing" property of motor nerves, shows that physical and anatomical considerations alone cannot decide the question, which is, in the end, one of physiology.

It does not seem impossible that investigations with the Einthoven galvanometer might throw light on the form of the impulses in the auditory nerve. Even if the wave-form were beyond the capacity of the instrument, the number of impulses per second in relation to those of the pitch of the note and the refractory period of the nerve might be determined.

Dr. Perrett's difficulties (NATURE, November 7) relate to the extent of spread of a resonant vibration and to the perfection of damping. It seems to me to be unreasonable to bind Helmholtz to exact numerical data, considering the enormous difficulties involved in the determination of the physical constants of the auditory apparatus. Nor are the numerical values used by Helmholtz for approximate calculations to be regarded as the "keystone of his theory." At any rate, the amplitude of a resonant vibration in a membrane decreases very steeply as the maximal point is departed from, and the fact that below a certain intensity of stimulus a nerve-fibre is not excited at all suggests the possibility that the amplitude of vibration may be sufficiently great to be effective only in immediate proximity to the maximum.

The sudden cessation of the perception of a sound when its source ceases, as required by phonetics, is, as Dr. Perrett is aware, a question of the perfection of damping. I fail to see why we are necessarily limited to any particular value of the reduction in a given time by the cochlear apparatus, be this value one-tenth or otherwise. The fact that a resonant vibration may be practically "dead-beat" was made clear to me in a recent experience at an orchestral concert. The floor-board on which one of my feet rested resounded by vibration to a particular note, especially to the powerful one of the trombone or drum. But the interest lay in the fact that this vibration ceased instantaneously as soon as the exciting note ceased, doubtless owing to the effective damping by the benches and the feet of the audience.

There is one phenomenon which has not been referred to hitherto in the present discussion: the disputed question as to whether the different compound wave-forms produced by different phase relations of the same component tones affect the quality of the sound heard. Helmholtz stated that they did not, but other observers have stated the contrary. Sir Thomas Wrightson's theory would be able to account for a difference, but the resonance theory would not. Unfortunately, the statements are very contradictory, and it does not appear that the experiments made by those who found phase relation to be effective were such as to exclude differences other than those of phase in the complex tones produced.

The desirability of a decision of the question at issue, if possible, may serve as excuse for a further letter on my part, for the length of which I beg to apologise. W. M. BAYLISS.

University College, London.

International Prize for Scientific Work.

I HAVE recently received from one of the secretaries of the Royal Academy of Turin a printed Latin notice of the conditions prescribed for the next award of an international prize of the net value of 9000 Italian lire founded by Cesare Alessandro Brussa, M.D. The prize is to be awarded to the *vir doctus* who has produced that which, in the judgment of the academy, is the most important and most useful invention or the most important work during the four years between January 1, 1915, and January 1, 1919, in any of the following departments of study:—Physics, or other branches of experimental science; natural history; mathematics (pure or applied); chemistry; physiology; pathology; geology; history; geography, or statistics.

Those who are proposing to compete for the prize are requested to send their inventions or their works to one of the secretaries of the academy (Prof. C. F. Parona, secretary for physical, mathematical, or natural sciences, or Prof. E. Stampini, secretary for moral, historical, or philological sciences) before January 1, 1919. Any works sent must be printed, but will not be returned (works in manuscript or typewritten are inadmissible). The academy may also award the prize to one who has not submitted any work. The prize is open *docto viro cujuslibet nationis*, but Italian members of the academy are not eligible.

Cambridge. J. E. SANDYS.

SCIENTIFIC GLASSWARE.

THE manufacture of scientific glassware must be regarded as a single industry rather from the point of view of its markets than from that of the processes employed. It includes, in the first place, several branches of the glass trade. Light hollow ware, such as beakers and flasks, are blown in the glasshouse, the mass of glass on the blowing iron being rotated during the process of blowing in the mould, so that no mould marks appear on the finished article. In this respect the processes are identical with those employed in the manufacture of lighting ware, and differ essentially from those of common bottle-blowing. Mechanical methods are largely employed in the finishing processes. The manufacture of heavy goods, such as desiccators, which may be pressed, blown in moulds, or partly or entirely made by hand, belongs to other branches of the trade. Tube drawing is an entirely different branch of the industry, important in itself and furnishing the raw material for the manufacture of light and delicate pieces of apparatus at the hands of the lamp-worker. Finally, we have the accessory trades of grinding, polishing, and graduating, and others of minor importance.

Prior to the outbreak of the war the blowing of light hollow ware in this country was practically confined to the manufacture of electric-lighting bulbs and gas globes, of which vast quantities, including the whole of the resistance lighting ware, were also imported. Beakers, flasks, and similar articles were entirely imported. Though the British glass-worker is probably the most highly skilled handicraftsman in the world, the whole of our heavy chemical hollow ware came from Germany and Austria, an occasional piece only, to a special pattern, being made in an English glasshouse. Tube drawing, principally for gauge glasses, was practised to a certain extent; but the whole of the high-grade glass for the lamp-worker came from Germany. Finally, our means of production of glass instruments, graduated or otherwise, stop-cocks, etc., were insignificant compared with our requirements, even in peace-time.

It is probable that in the month of August, 1914, and for many months later, no Government Department appreciated the fact that the successful carrying on of the war depended in a large measure on the maintenance of the supply of scientific glassware. In this case, as in the case of other essential goods or materials which had previously been imported from enemy countries, no attempt was made to organise production, which was left to private enterprise.

The manufacture of such goods as beakers and flasks was not an attractive enterprise, particularly as a four-year war appeared to be outside the bounds of possibility, and there seemed little prospect of retaining the industry after the conclusion of peace. However, not many weeks had elapsed before Messrs. Baird and Tatlock (London), Ltd., Messrs. Moncrieff, of Perth, and Messrs. Wood Bros., of Barnsley, decided independently to venture in the national interest, the first-named by building a new glassworks (Duroglass, Ltd.), the others by extending their existing glassworks. Within a year of the declaration of war British flasks and beakers were on the market.

Those of us who are interested in chemical hollow ware must have a painful recollection of the exhibition held in the rooms of the Chemical Society in November, 1915. It showed that beakers, flasks, etc., were being made in this country, and from resistance glasses, and gave hope for the future; but the goods exhibited can scarcely have been said to show either the regularity in thickness or the finish to which chemists had been accustomed. The exhibit of the British Chemical Ware Manufacturers' Association at the British Science Guild's Exhibition at King's College in August last will, we hope, wipe out the memory of the earlier days.

While scientific literature contains scant information on the subject of glass, a good deal of information was available to those who knew where to look for it. The dealers in glassware possessed extensive information as to the varieties of German and Austrian glass which had been imported. Samples of the glasses were easily acquired, and when these were analysed information was obtained which, combined with a working knowledge of commercial materials, was sufficient to enable a chemist to work out formulæ for the glasses. The formulæ might be slightly modified after trial in the glasshouse, but the actual production of glasses identical with, or even superior to, those which had previously been imported presented no particular difficulties.

At every stage in the manufacture of light hollow ware new processes and methods of working had to be devised, and old prejudices of the British glass trade fought down. The design of moulds, the working of the glass on the iron, and the blowing in the mould had to be studied carefully so as to ensure uniformity of production. The annealing of the glass, which differed in its behaviour from the usual British glasses, required particular attention. The finishing of the goods was at first carried out by skilled men in the glasshouse, but it soon became necessary to replace the man by the girl and the machine.

Success in every trade depends largely upon organisation. In the English glass trade the furnace has been used as a means of melting glass during the week-end, and of keeping it hot during the week while the goods are being made. In modern glassworks practice a furnace is looked upon as a machine for melting glass, the pots being worked out as fast as possible, any reheating of articles during working being performed in subsidiary furnaces, called glory holes. In the most modern type of furnace the glass is melted by night, and the pots are worked out every day and filled again, so as to be ready for the next day. This is probably the best kind of furnace for working light scientific and lighting hollow ware, and in working other classes of goods the furnace must be suited to the work, so as to reduce the furnace charges, one of the heaviest costs, to a minimum. Next, it is important that the lehrs, or annealing ovens, should be suitably designed and placed near the furnaces, for on the efficiency of the annealing much depends. The annealing loss carries with it the whole of the corresponding labour and furnace charges, and it may make the difference between success and failure. On the efficiency of the annealing will depend the loss in the processes of "cutting off" and finishing. To the second annealing, during which the strains introduced in the finishing processes are removed, close attention must be paid, for if the flanges crack off flasks while in use, chemists are inclined to show irritation. Finally, the organisation of the handling of such fragile goods is of the first importance, for casual breakage may easily run away with the whole of the profits.

The exhibits of the British Chemical Ware Manufacturers' Association and of the Flint Glass Makers' Association show what progress has been made during the war in the manufacture of heavy hollow ware, but the processes employed can scarcely be said to be new to this country. These associations, and the British Lamp-blown Scientific Glassware Manufacturers' Association, have also turned their attention to the manufacture of lamp-blown goods and graduated glass instruments, the supply of which has risen in both quality and quantity to meet the national needs. In these branches of the industry some progress has been made in introducing new and improved machinery; but as for some time past it has been very difficult to get machinery constructed, even the most progressive firms have been considerably hampered.

In spite of all the difficulties which he has had to face, the British manufacturer may claim that he has gone a long way towards solving the new problems of glass manufacture, and making the country self-supporting in the matter of scientific glassware. It is true that prices are high. But the cost of manufacture is practically three times as high as it was before the war, and all branches of the industry are burdened by heavy capital charges on account of new works erected or old works modified and improved. Heavy taxation has not tended to cheapen production.

This is a heavy handicap at the outset, and it must not be forgotten that the majority of works in which the goods are being made were not designed for the purpose to which they have been applied during the war, and much new construction has been carried out with a view rather to rapidity of execution than to ultimate efficiency. Also, though much has been learned, there remains much for the British glass manufacturer to learn if he is to compete on equal terms with his foreign rival. Finally, wages and expenses in Great Britain are likely to remain at a higher level than on the Continent and elsewhere.

No one supposes, that the cost of manufacture on the Continent will fall to anywhere near pre-war rates, but, all other things being equal, the Continental manufacturer will still have the advantage of having his furnaces and plant in good repair, while those in British works will have been worked for five years up to the limit. He will also be burdened by smaller capital charges, and will be in a very advantageous position from the point of view of cheap production. It is clear, therefore, that this industry, *which is the key to every other industry*, cannot be maintained in the country without adequate protection and effective assistance from Government.

The establishment of the Department of Optical Munitions and Glassware Supply, Ministry of Munitions, not only for the purpose of organising the manufacture of munitions of war, but also with a view to the future development of the industry, may be taken as indicating the policy which the Government proposes to adopt. Assured of the support of the State, the manufacturers are prepared to do their utmost to hold on to what they have won; and through their trade associations, as well as the newly formed Society of Glass Technology, with its headquarters in Sheffield University, they are doing their best to organise for the future. MORRIS W. TRAVERS.

A "MINISTRY OF WATER."

A DEPUTATION representative of the National Sea Fisheries Protection Association and of other fishery interests waited on Mr. Prothero, President of the Board of Agriculture and Fisheries, on Wednesday, November 27, and made proposals for the establishment of a British Ministry of Fisheries, marine and freshwater. A memorandum published by the Fishmongers' Company was submitted. The proceedings of the conference are fully reported in the *Fish Trades Gazette* of November 30.

The memorandum is a careful, and even scholarly, piece of work. Beginning with a concise account of the development of the modern fishing industry, it proceeds to summarise the conditions that existed on the outbreak of war, and then traces the effects that may be expected when demobilisation is complete. In 1913 there were about 3700 steam- and motor-driven vessels, besides a larger number of smaller boats. About a million and a quarter tons of fish were landed in that year, and rather more than half was exported, about 600,000 tons being consumed in this country. Of this quantity about 18 per cent. was distributed by the fried-fish shops (the "National Kitchens"). During the progress of the war about 3000 of the steam vessels, with 40,000 to 50,000 men, joined the Royal Naval Reserve. They "saved the Navy and the Navy saved Britain," while those who were left continued to feed the people. Exports largely ceased, and the smaller vessels increased their production, with the result that, in 1917, about 400,000 tons of fresh fish were still available as human food. "The public," says the memorandum, "are voluble in their expressions of gratitude to the fishermen," and it then proceeds to set out the ways in which this gratitude can best be expressed—and future favours ensured.

The beginning of demobilisation sees the almost complete breakdown of the pre-war conditions of production and distribution. The fish docks and harbours were inadequate in 1913, and they are still more inadequate to-day; there are unfair railway rates, and delays and inconveniences in transport and handling (there are not enough fish-boxes in the country at present to contain the catch to be expected in a few months); while the machinery for retail distribution has broken down as the result of the Military Service Acts. Already there are powerful competition from Norway and an almost unbelievable reorganisation and extension of the German sea fisheries (see appendix v. of the memorandum). Obviously there must be increased production here; new means of capture; discovery of new grounds and regeneration of old ones; policing and regulation, both international and national; industrial experiment, training, education, and research. There must be an end of the "Victorian fallacy that science can be hired for the wages of unskilled labour"; reliance by the trade on the results of investigation; co-ordination of commercial and consular activities; search for new markets; and salvation "from the inanities of doctrinaire politicians."

All these objects are clearly unattainable as things are. Why? A glance at appendices i. and ii. of the memorandum will show. There are a multitude of authorities, national, central, and local, each of them "doing its bit"—or not; each more or less unco-ordinated with the rest. To secure effective joint action by this complex is obviously impossible. So there must be a Ministry of Fisheries with an Imperial General Staff, and strengthened and simplified English and Scottish authorities. (The inclusion of Ireland is, apparently, hopeless as yet.) The memorandum outlines a scheme for a Ministry, adopting, to a large extent, that of the United States Bureau of Fisheries.

Disregarding sectional jealousies, the scheme cannot fail to obtain approval by anyone who knows the conditions. Now for Mr. Prothero's reception of it. The Minister was, doubtless, disappointed by the presentation of the case by the deputation. About an hour was set aside for speeches, and most of this time was taken up by the chairman and vice-chairman, by Sir J. Crichton-Browne, who spoke about rearing pedigree cod, and by Mr. J. Arthur Hutton, who dealt with river pollution and the national importance of the salmon fisheries (which yielded 0·2 per cent. of the 1913 total catch). That was about all. The fishermen themselves were unrepresented, and (judging from the speeches reported) so were the fish-friers, the retail trade, and the preservation and canning industries.

Mr. Prothero's reply must have been equally disappointing. The Board of Agriculture and Fisheries was, he indicated, almost powerless with regard to many important matters, and a united Ministry of Fisheries for the United Kingdom would probably be the best authority. But it would be expensive; it would add to the number of officials and to bureaucracy generally—and we had had too much of that. He could not speak for Scotland or Ireland. He could not see that a Ministry of Fisheries could free itself from the Board of Trade or Admiralty, nor would it be of "sufficient calibre" to carry weight. So as an alternative he suggested the formation of a "Ministry of Water." "Why not sever land from water?" Then, after some wholesome platitudes as to the national services of the fisher-folk, the Minister pleaded other engagements.

So the matter remains, awaiting the attention of some statesman who can put aside other engagements—or that of some wholly independent organisation which can influence the public and so supply the driving force without which politicians seem unable to move.

THE PROMOTION OF SCIENTIFIC AGRICULTURE.

WHEN, in his recent speech at Wolverhampton, the Prime Minister spoke of the need for promoting scientific agriculture, he touched upon a subject of great national importance, and it may be profitable to attempt to give significance to his words. As was pointed out in the last issue of NATURE, it may be that what Mr. Lloyd George had in mind was merely the extended use of artificial manures, the discovery and methods of use of which were undoubtedly scientific discoveries of the first magnitude, with which the name of Lawes and his experimental station at Rothamsted will ever be honourably associated. But we should like to think that the passages in the speech to which attention was directed are evidence that the Prime Minister has advanced to a position which few of his political forbears ever reached, namely, that progress in the arts and industries is indissolubly bound up with the progress of science; and science in this connection should not be limited to the "natural" sciences. The application of the scientific method to technical problems may well be as potent an element in progress as the adoption of the results of scientific research properly so-called. The field experiment in agriculture may not be research, but it is futile as an *experiment* unless it is conducted under the conditions and interpreted with the precautions which science dictates.

If, then, the Prime Minister has resolved that agriculture shall benefit from science, his first task is to take such measures as are likely to be fruitful of results. It will not suffice merely to provide unlimited funds even on the scale of a "day's cost of the war," if at the same time a well-considered plan of operations has not been framed. Scientific research in agriculture in the past has suffered from a failure to attract a sufficient number of men of first-class scientific talent. This failure has been largely due to the fact that agricultural research offered no career. Not only were such posts as were available inadequately paid, but essential needs, such as well-equipped laboratories with adequate provision for maintenance, had not been provided.

In the forefront, therefore, of the measures that should be taken to link together practical agriculture and science should be placed the recruitment of the best scientific talent that the country can provide, and this can be secured only by providing suitable openings with reasonable prospects of advancement for the best of the graduates in science turned out annually by the universities. Programmes of research avail nothing in the absence of competent men to carry them out. We should like to see a scheme inaugurated under which promising graduates in science would be attracted to the study of the agricultural sciences by the provision of special fellowships under a guarantee that a certain number would eventually be selected for permanent posts carrying adequate salaries.

It is true that in the past most of the great discoveries have been made by men actuated merely by a love of knowledge for its own sake, and no doubt the future will not differ from the past in this respect; but the real point is that, if anything is to be accomplished by State action, an appeal must be made to the motives by which the majority of men are actuated in choosing their life career. There can be no question that if emoluments were placed upon a basis which would enable workers to live in reasonable comfort, while prospects of advancement were also improved, the fruits of the vineyard would be ample. Agriculture and horticulture are still in the main ruled by empiricism and tradition, and while it is true that many of the more recent advances in science go to confirm the wisdom of the ancients, no one can doubt that we are still far from possible ends in many directions. Scientific methods of plant breeding alone are capable of indefinite expansion. Scientific methods of controlling plant diseases can be foreshadowed with considerable confidence. The crop-bearing capacity of the soil may, as Mr. Lloyd George suggested, be increased by scientific means, and in the region of diseases of live stock the possibilities of progress have scarcely been explored.

The Prime Minister's declaration should not be forgotten. If agriculturists are alive to their interests they will see that it is not allowed to lapse into the oblivion which so ruthlessly overwhelms many of the platform promises of politicians.

NOTES.

In a letter to the *Times* of November 28, under the heading of "Gas Warfare," appears a plea for the establishment of "fresh safeguards" to prevent any nation from ever again employing gas as a weapon. The letter is signed by eight of the most highly placed members of the medical profession, who know from experience what immense suffering has been caused from the employment of asphyxiating gas in the present war. Those who have knowledge of the operations of our own gas offensive service will tell us that there must be very many of our present enemies who will heartily agree with the views expressed in this letter, so that on this point opinion would no doubt be unanimous. One of the objections raised in the letter to the *Times*, that gas is not a controllable weapon the effects of which can be limited to combatants, cannot be regarded as more true for gas when used under modern conditions than for shrapnel or high-explosive shells. There remains the view that the use of gas involves needless suffering; this argument applies with equal force to all the operations of war. If in the coming comity of nations mutual confidence can extend so far as to agree to the abolition of a form of warfare which has now been removed from the realm of theory (and in theory gas warfare is at least a century old) to that of accomplished fact, surely it can go one small step further and so abolish war altogether. This would be a more practicable measure; preparations to arm would attract attention, while preparations for this particular form of armament could be carried on in secret by any Power so inclined. In past wars the issue has been determined almost solely by military skill and valour; in the present war there has been an increasing application of scientific knowledge. Science has not merely striven to destroy enemy life; it has striven, and with equal success, to save British and Allied lives. The British pattern of gas respirator is the triumphant product of much exceedingly careful work, and has probably saved more lives than any other contrivance or procedure adopted during the war. Whether it is decided to drop the use of gas or not, it would be extremely unwise for us to discontinue to train our men in anti-gas measures unless general disarmament is agreed upon.

It might reasonably be expected that by now most people would know more about the aims and ideals of science than to repeat the old formula that science is in opposition to religion and detrimental to culture, yet in the *Scientific Monthly* (vol. vii., No. 5) Mr. E. P. Lewis finds it necessary to protest in an article entitled "The Ethical Value of Science" against the attitude of many current writers who directly or indirectly express such views. He quotes from various recent articles to the effect that science is largely responsible for the extirpation of culture and the growth of materialism; some writers attribute the war to the suppression of spiritual values by the influence of scientific doctrines, and its horrors to malignant investigators who spend their lives devising agencies of death and destruction. Such people overlook the fact that the statesmen immediately responsible for the outbreak and conduct of war are not scientific men. Science has nothing whatever to do with conquest, with commercial exploitation, or with upholding the divine right of dynasties. The end of all scientific investigation is to discover the truth about all things, including man, his instincts and impulses, his organisation in society. Were economists and politicians imbued with the scientific spirit it would be of incalculable benefit to the effective organisation of society. Science has no intention of decrying genuine religion, or of denying the importance of the so-called humanities, but it does maintain that the habit of mind developed by scientific studies is at least as important as an ethical agency. With the completion of the war it will be in a large measure the mission of science to rebuild a shattered civilisation; it will restore industries, house the homeless, feed the hungry, and cure the sick, and, not least, must aid in healing the deep-seated ills of society, the consequences of past social misconduct. If men will use for destruction the discoveries of science, it is not the scientific worker who is to blame.

IN his recent speech at Wolverhampton Mr. Lloyd George, when referring to agriculture, spoke of the possibility of providing a national supply of fertilisers. It seems likely that a scheme has been put before him for the continuance of the present arrangements under which the Ministry of Munitions controls the manufacture of artificial fertilisers. In fact, it may be that the intention is that the State should actually undertake the manufacture of certain fertilisers. It is common knowledge that there are now in existence a number of State-owned sulphuric acid factories, and, further, that, inasmuch as the State has agreed to purchase a large proportion of the Australian output of zinc ores containing sulphides of the metal, it will be in a position to control the sulphuric acid output of the country. A State-owned supply of sulphuric acid naturally suggests the State manufacture of superphosphate and sulphate of ammonia in the interests of increased food production. Schemes of this nature for State trading of many kinds are likely to be put forward, but whether they will survive the opposition of manufacturers is perhaps doubtful.

IN London the Registrar-General's returns show a very substantial decrease in the number of deaths from influenza in each of the two weeks ending November 16 and 23. The climax of the epidemic was attained in the two weeks ending November 2 and 9, in both of which influenza caused 57 per cent. of the deaths from all causes, whilst for the week ending November 23 only 42 per cent. of the total deaths were due to influenza. The epidemic has caused 9441 deaths in London during the seven weeks ending November 23, which is 47 per cent. of the deaths from all causes, whilst the percentage of deaths from pneumonia was 12, and from bronchitis 6. Chicago during the two weeks ending October 19 had respectively 571 and 1242 deaths from influenza, whilst in London the deaths were 80 and 371. In Paris the deaths for the week ending November 9 were 629, which is a decrease of 490 on the preceding week, whilst in London the decrease of deaths was 25 for the corresponding week. The closing week of November experienced a return of milder and more humid weather, and this possibly may lessen the continued decrease in the deaths from the epidemic. The re-issue of the weather tables in the Registrar-General's returns is a welcome feature. The meteorological results for certain towns are already recommenced, and the table of Greenwich daily values is promised from the beginning of next year.

WE regret to learn from *Science* of the death of Mr. H. S. Coe, agronomist in the United States Department of Agriculture, and author of numerous botanical and agricultural papers, on October 25, at thirty years of age; and of Prof. W. G. Mallory, associate professor of physics in Oberlin College, on October 19.

WE regret to note that the death of Mr. Edmund Sharer is recorded in *Engineering* for November 29. Mr. Sharer, who was sixty-two years of age, was, up to a few years ago, shipyard director at the Dalmuir naval construction works of Messrs. William Beardmore and Co. He was responsible for the construction of many notable naval and mercantile vessels, and was a member, since 1894, of the Institution of Naval Architects.

BY the death on December 3, at eighty-four years of age, of Dr. John Percival, formerly Bishop of Hereford, the nation has lost a vigorous worker and independent thinker whose whole active life was devoted to the furtherance of progressive aims. Dr. Percival was the first headmaster of Clifton College, and during his fifteen years' work there he brought this public school to the high position which it occupies. He was one of the founders of University College, Bristol, and took a leading part in all educational matters, particularly the education of women and the extension of university teaching. From Clifton Dr. Percival went to Oxford in 1878 as president of Trinity College, and in 1887 he became headmaster of Rugby School, where he had formerly been an assistant master. He was nominated Bishop of Hereford in 1895, and while in the Upper House he maintained on all occasions the broad principles and courage in expressing them which distinguished his career. He was the author of "The Universities and the Great Towns," and was president of the Educational Science Section of the British Association at the Cambridge meeting in 1904.

THE death is announced of Mr. G. P. Rose, C.I.E., who began his career on the Indian State railways, and afterwards acted as executive engineer in the construction of the Chappar Rift works and bridge in the sand-swept, tortuous defiles of the river gorge on the Sind-Peshin railway. Mr. Rose also won the respect and confidence of the gangs of wild border men—Afridi, Waziri, and Baluch—upon whose assistance the success of the work depended. He superintended works on the line from Quetta to New Chaman and the Khojak tunnel. After acting as deputy manager of the North-Western State railways, his services were lent to the Nizam's Government, and he afterwards became junior consulting engineer to the Government of India. After his retirement in 1904 he joined the board of the Hyderabad (Deccan) Mining Co.

THE death is announced, at the age of eighty-six, of Mr. N. C. Macnamara, consulting surgeon to Westminster Hospital, and vice-president of the Royal College of Surgeons in 1893 and 1896. Mr. Macnamara was appointed assistant surgeon in the Indian Medical Service in 1854, and became surgeon-major in 1873. During his career in India, which ended in 1876, he wrote on diseases of the eye, the history of Asiatic cholera, and other medical subjects. Returning to this country, he was in due course appointed surgeon and lecturer on clinical surgery at the Westminster Hospital, and later became consulting surgeon to the Westminster Ophthalmic Hospital. He published, among other works, "Lectures on Diseases of Bones and Joints" and "Instinct and Intelligence," which was published in 1915, when he was eighty-three years of age. In addition to numerous other activities, Mr. Macnamara was a member of the Departmental Committee on the Army and Navy Medical Service appointed by the War Office in 1889, a member of the Government of India Commission on Leprosy, and president of the Commission of the British Medical Association on Medical Education and a Teaching University for London.

THE last of the first series of lectures arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, December 11. The chair will be taken at 4.30 by the Marquess of Salisbury, K.G., and a lecture on "Science and Industry" will be delivered by Sir William S. McCormick, of the Department of Industrial and Scientific Research. Applications for tickets should be made to the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4.

A GENERAL discussion on "The Relation of Science to the Non-ferrous Metals Industry" will form the central feature of the forthcoming annual general meeting of the Institute of Metals. At that meeting there will also be presented several important papers, the publication of which has been withheld owing to the operation of the censorship. The meeting is, therefore, to be anticipated with interest, as is also the annual May lecture, which will be delivered by Prof. F. Soddy on the subject of "Radio-activity." A local section of the Institute of Metals has been formed in Sheffield, the recently dissolved Sheffield Society of Applied Metallurgy forming the nucleus of the new section. The roll of the institute has increased by more than two hundred during the current year, and, in view of the probable advent of peace, it is expected that a total of 1200 members will soon be recorded, and that within a few months of the institute's tenth birthday.

THE first part of what will prove an extremely valuable report on the mammals of equatorial East Africa has just been issued by the United States National Museum (Bulletin No. 99). This is the work of Mr. N. Hollister, and embraces the Insectivora, Cheiroptera, and Carnivora. While great attention has been paid to synonymy and tables of measurements—matters of very real importance—a considerable amount of space has been devoted to notes on life-histories furnished by the various field collectors on expeditions sent out by the Museum during the last few years. No fewer than sixty type skulls are figured here for the first time. Furthermore, those interested in the phenomena of variation and in the skeletal changes wrought by captivity will find in this report some very striking facts.

SOME very disconcerting figures anent the slaughter of penguins for the sake of their oil appear in the *Victorian Naturalist* (vol. xxxv., No. 6). We are assured that, though as many as 1,500,000 are annually killed for this purpose, the colonies show no diminution in their numbers. We are glad to know that a representative of the Australian Ornithologists' Union is to visit the islands during the coming slaughtering season to investigate the charges of cruelty made against those engaged in this traffic, and also the assurances which have been given that, though the birds are slain by the million, their numbers show no reduction. This scarcely seems credible. Ornithologists the world over look with grave misgivings on the continuation of this devastating work, to which we trust an end will speedily be put.

THE observations on the nesting habits of the bullfinch by Miss Frances Pitt, which appear in *British Birds* for November, deserve the careful attention of students of animal behaviour as well as of ornithologists. During incubation, Miss Pitt remarks, the female is fed entirely by the male, and for the first six days after the hatching of the young he feeds both his mate and their offspring. He also, for the first few days, attends to the cleaning of the nest, passing some of the excrement to the female to swallow, and disposing of the rest himself. After the first day or two both parents undertake the removal of the excrement, which is no longer eaten, but carried off and dropped at a distance. At first the young are fed at intervals of about fifteen minutes, but by the time they are ready to fly nearly an hour elapses between each meal. As with so many young birds, the nestlings are greatly distressed by the midday heat, and lie gasping for breath, with their heads hanging over the edge of the nest. Each parent has its own path, which it invariably uses in returning to and departing from the nest—a trait which appears to be common to most birds. By the eighth day the nestlings show signs of developing feathers, and begin even to attempt to preen the growing stumps, probably to allay slight uneasiness, akin to itching, due to the ferment of vigorous growth.

DR. A. L. DU TOIT (Trans. Geol. Soc. S. Africa, vol. xxi., p. 53, 1918) describes an interesting intrusion of aplite into serpentine in Natal. The aplite has become overcharged with alumina, which has separated as corundum, while the serpentine has become penetrated by silica and locally converted into talc. The ferrous iron of the serpentine has separated out completely as minute octahedra of magnetite during the process. The same paper describes the occurrence of two sheets of magnetite containing ilmenite in a gabbro in the Tugela Valley. These cannot have separated by gravitation from the gabbro, and are regarded as intrusive bodies which retained their fluidity and oozed upwards under squeezing processes from the lower portion of the cauldron, leaving behind a residue of pyroxenes, and corroding and including silicates that had already separated in the overlying gabbro.

THE report of the fifth Indian Science Congress held at Lahore in January last, published in the Journal of the Asiatic Society of Bengal for August, consists of the usual presidential addresses and short abstracts of upwards of ninety papers; but with a few exceptions, notably in the sections of physics and zoology, the addresses and papers deal mainly with matters of economic, agricultural, and commercial interest. Without disparagement, the report may be said to illustrate chiefly the interested official view of science, which is fixed steadfastly on material benefits rather than lifted into the grand realms of creative imagination. From a considerable mass of such useful information we extract the interesting statement that, as one of the results of the war, several distilleries for the extraction of essential oils have been established in Southern India, and that experts now have confidence in the ability of India to supply the world's demand for sandal-oil and thymol. In the papers of purely scientific interest Messrs. Southwell and Baini Prashad have followed out the life-history of a new tapeworm of a shark, which passes its larval stage in the muscles of the Indian shad; Mr. M. J. Narasimhan mentions the isolation of a bacillus from root-nodules of Casuarina, which behaves like the nitrogen-fixing bacillus of the root-nodules of Leguminosæ; Messrs. E. Vredenberg and Das Gupta report the discovery at last of Upper Palæozoic fossils in the Krol beds of the Simla region; and Mr. C. A. Matley gives a brief description of Dinosaur remains from the Lameta beds of Jubbulpore.

THE forty-seventh annual report of the Deputy Master and Comptroller of the Royal Mint has just been issued. It refers to the operations of the year 1916. The total number of coins struck was 265·5 millions, which was nearly 59 millions more than in 1915, and is the highest figure on record. Owing to the continued withdrawal of gold from circulation, the great demand for silver coin which arose in the previous year was continued, and no fewer than 127 million pieces were struck, against an average of 49 millions for the previous ten years. A very great increase in copper coinage also took place, and 136·8 million coins were struck. On the other hand, only 1·5 million gold coins were struck, as compared with an average of 24 millions in the previous ten years. The sterling value of the total coinage in 1916 was 10,386,137*l*., as compared with 29,385,568*l*. in 1915. During the year the Mint, Birmingham, Ltd., struck 33·7 million coins, under the supervision of the Royal Mint, for British Colonies and Dependencies. This firm also supplied the Royal Mint, for Imperial coinage, with silver and bronze blanks. The general account of expenses and receipts shows a profit of 4·5*l.* millions, as against 4·7*l.* millions in the previous year. The principal item included is the profit on the silver coinage, but although the issue of silver coins in 1916 was greater than in 1915, the higher cost of the bullion resulted in a reduction in the net profit under this head. Receipts of work done for the War Office show a considerable increase in value, but the suspension of Colonial coinages has resulted in the disappearance of any item on this account. As was to be expected, general expenses were decidedly higher than in previous years.

THE important bearing on the food supply of artificial manures containing phosphorus lends particular interest to a communication by Dr. C. Doelter in the *Oesterreichische Chemiker- und Techniker-Zeitung* for September 15 and October 1 regarding the mineral wealth of the Ukraine. Phosphorite is found there in many districts, in some parts in great abundance. Large quantities are said to be obtainable from open-cast workings at low cost. Ground phosphorite was exported to Austria in considerable quantities before the war. It generally contains a high percentage of calcium phosphate, while analysis shows 27·5 per cent. of phosphoric acid. To derive the full value from the deposits they should be worked systematically, and not by the primitive methods employed formerly.

DR. BECKMANN recently gave an account before the German Institution of Electrical Engineers of the progress that has been made in training disabled soldiers to enable them to carry out work in engineering factories. A number of photographs are reproduced in *Elektrotechnische Zeitschrift* for September 19 and 26 (in which the account is published) showing the methods adopted to enable such men to operate machine-tools. Particular stress is placed on the success of a method, devised by Dr. Krukenberg, to enable soldiers who have suffered amputation of the forearm to work machines. A further communication by P. Perls refers to the employment of the blind in factories. The photographs show men at work on a variety of machining operations and the means of protecting them from accidents. It is stated that blinded soldiers have been employed with success in twenty-six occupations.

THE law of decay of phosphorescent light emitted by a body after stimulation has hitherto been taken to be of simple form. If I is the intensity and t the time since stimulation, I was taken inversely proportional to $(a+bt)^2$. According to a communication to the National Academy of Sciences of America by Prof. E. L. Nichols and Mr. H. L. Howes, which appears in the October issue of the Proceedings of the Academy, the law of decay is not so simple. They find that there are two types of decay for the phosphorescence of short duration. If the inverse square root of the intensity as ordinate is plotted against the time as abscissa, in the first type the curve rises as the time increases, but the rate of rise decreases as time goes on; and in the second the curve rises, and the rate of rise increases with the time. The first type of phosphorescence the authors propose to call the "persistent," and the second the "vanishing," type. The two types may be exhibited by the same material, *e.g.* calcite, stimulated by ultra-violet light, gives phosphorescence of the vanishing, and, when stimulated by cathode rays, of the persistent, type.

AMONG forthcoming books we notice "Technical Handbook of Oils, Fats, and Waxes," P. J. Fryer and F. E. Weston, vol. ii. (*Cambridge University Press*); "Lice and their Menace to Man," Lieut. Ll. Lloyd, with a chapter on "Trench Fever," by Major W. Byam, R.A.M.C., illustrated (*Henry Frowde and Hodder and Stoughton*); "The Iron Circle: The Future of German Industrial Exports," Prof. S. Herzog, translated (*Hodder and Stoughton*); "Textbook of Military Aeronautics," H. Woodhouse (*T. Werner Laurie, Ltd.*); "Boiler Chemistry," J. H. Paul, a new edition of Bale's "Handbook for Steam Users" (*Longmans and Co.*); and "The Mechanics' and Draughtsmen's Pocket-book," W. E. Dommett, and a new edition of Poole's "Telephone Handbook" (*Sir Isaac Pitman and Sons, Ltd.*).

OUR ASTRONOMICAL COLUMN.

DISTRIBUTION OF GLOBULAR CLUSTERS.—In continuation of his previous investigations of the distances of globular clusters, based upon the interdependence of absolute luminosity and period in the case of Cepheid variables, Dr. Harlow Shapley has reached important conclusions regarding the extent and arrangement of the sidereal system (Proc. Nat. Acad. Sci., vol. iv., p. 224). The clusters appear to form a large flattened system, the centre of which is in the galactic plane, at a distance of between sixty and seventy thousand light-years, in the general direction of the star-clouds of Sagittarius and Scorpio. The arrangement of the clusters and the relative densities of various parts of the Milky Way clouds strongly suggest that the whole sidereal system is roughly outlined by the globular clusters, and that stars, nebulæ, and clusters are all members of a single unit. The mean diameter of the proposed system appears to be at least 300,000 light-years. A further investigation has verified the existence of a local cluster of stars having a diameter of about 2500 light-years, and containing most of the brighter B stars, a majority of the A stars, and many stars of redder spectral types. The motion of the cluster as a whole is in the galactic plane, and nearly radial from the galactic centre. The observed systematic motions of the stars may be explained by the movement of the cluster through the general field of stars.

A NEW TYPE OF NEBULAR SPECTRUM.—Dr. V. M. Slipher has made the interesting discovery that two of the variable nebulæ give an emission spectrum which is quite unlike that of the ordinary gaseous nebulæ (Lowell Obs. Bull. No. 81). The spectrum of Hubble's variable nebula, N.G.C. 2261, was photographed in December, 1917, with a total exposure of nearly thirty-seven hours, the slit being placed north and south over the nebulosity and nucleus. In most essentials the spectrum of the nebula is identical with that of a new star in the early bright-line stage, when the majority of the lines, other than those of hydrogen, are identical with enhanced lines. The resemblance to the typical nova spectrum is further emphasised by the presence of absorption bands on the more refrangible sides of the bright lines of hydrogen. The variable nebula N.G.C. 6729 reaches only a low altitude at Flagstaff, but, so far as can be judged from the photograph obtained, its spectrum is a duplicate of that of Hubble's nebula. The latter is of "cometic" form, and the nucleus is the variable star R Monocerotis, which was of the 12th magnitude when the spectrum photograph was obtained. The light of the nucleus is identical with that of the nebula, and it is therefore probable that the nebulosity derives its light from the star. The further study of these objects may well be expected to throw considerable light on the nature of temporary stars.

SPECTRUM OF THE CORONA.—Several additional faint lines have been found in the spectrum of the corona by the Rev. A. L. Cortie, S.J., on photographs taken at Hernösand, Sweden, during the total eclipse of the sun on August 21, 1914 (Monthly Notices, R.A.S., vol. lxxviii., p. 665). In the region extending from 6615·7 to 4780 A thirty-six lines were measured, of which twenty-four do not appear in any previous records. The wave-length of the prominent red line which was first noted at this eclipse is given as 6373·3.

AGUE IN ENGLAND.[1]

IN 1917 there were reported 136 military, 19 naval, and 23 civilian cases of malaria contracted in England, *i.e.* in people who had not been out of the country. Fifty-three of the military cases occurred in the Sheerness and Sheppey areas, and fifty-three in the Sandwich area. As these cases, all of simple tertian malaria, began to arise, the attention of medical officers of health and other medical men was directed to the matter by the Local Government Board, and the problem of the possible danger to the civilian population of the influx of malaria-infected soldiers from abroad was considered. This report records the action that was taken to deal with the situation, and that it is proposed to take should the cases assume any serious magnitude in 1918.

It would appear from the information collected that the evidence is fairly clear that malaria had not completely died out in this country, as was generally thought to be the case, perhaps, with very rare exceptions; but, on the other hand, the cases in 1917 were a new phenomenon, and there can be no reasonable doubt that the cause of these cases was the new supply of infection, viz. soldiers from overseas.

Whether the whole official action as recommended in this report has not been "much ado about nothing" it is, perhaps, a little premature to say, but it was noticeable in some areas in 1917 that, although there were numerous infected soldiers, the number of indigenous cases that occurred amongst the surrounding non-infected population was in some instances a solitary one, giving ground for the hope that in 1918 the number of cases might still be small, and not such as to be dignified by the term "epidemic." Should, however, an epidemic occur, the problem of the best line of action has to be faced. We agree with the view expressed in the introduction of the report, that "comprehensive anti-mosquito work is impracticable," and believe that the use of quinine would make such work unnecessary. It is true that we cannot by the use of quinine "disinfect," *i.e.* destroy *all* the parasites in a person's system, but we can readily do so partially—*i.e.* we can, in these cases of simple tertian malaria, by adequate doses of quinine, render *the blood* completely free from all parasites, sexual as well as asexual, for long periods (months), so that, as regards Anophelines, such cases are non-infective, and, of course, equally so are the Anophelines. We believe that civilians would readily acquiesce in such treatment, all the more when they appreciated the fact that thereby they were kept free from fever and got a better chance of ultimate recovery. The report contains a special article on the microscopic diagnosis of malaria, but medical men can be taught this only by practical work in a laboratory.

The map showing the distribution of Anophelines in England, prepared by the British Museum authorities, contains some omissions which might have been filled had inquiries been made in likely quarters.

[1] Reports to the Local Government Board on Public Health and Medical Subjects. (New Series No. 119.) Reports and Papers on Malaria contracted in England in 1917. (London: H.M.S.O., 1918.) Price 4s. net.

NATURAL INDIGO MANUFACTURE.

IN "Indigo Publication No. 3," issued by the Agricultural Research Institute at Pusa, Mr. W. A. Davis, indigo research chemist to the Government of India, directs attention to a method of avoiding the loss of dyestuff which frequently occurs in the manufacture of natural indigo, due to finely divided particles of the dye remaining suspended in the large volume of extraction water (seet water) which is run off after "beating" is finished and the indigo has apparently settled. In indigo factories where working conditions are good the water running from the filtering tables is of pale sherry colour, but where fermentation in the vats is unsatisfactory, or the quality of the indigo plants grown in the neighbourhood is poor, the water finally run off may be distinctly green in colour, due to finely divided, suspended indigo. Of the two kinds of indigo plant grown in India the loss from this cause is greater with the Sumatrana than with the Java variety, as the former requires a large volume of water for extraction.

The settling agent which Mr. Davis suggests for general use is Dhak gum, a ruby-coloured gum produced by the Dhak or palas tree (*Butea frondosa*). This material has occasionally been employed for the purpose in the United Provinces, and was first brought to Mr. Davis's attention by Mr. Kenyon, of Sultanpur. Trials of the gum as a settling agent were made at a number of indigo factories in Bihar last season, and gave excellent results, the yield from Sumatrana plant at one factory being increased by 37½ per cent., and from Java plant at another factory by 16 per cent., these being average increases throughout the working period. The results of analyses of indigo made at various factories, with and without the use of Dhak gum, showed that the addition of this material to the settling-vat had no appreciable effect on the quality of the dyestuff produced. Further, it was at the factories where the fermentation conditions were unfavourable, or the quality of the plant used was poor, that the use of Dhak gum gave the best results, both in facilitating settling and filtration and in increasing the yield of dyestuff.

DYES AND THE DEVELOPMENT OF BRITISH CHEMICAL INDUSTRY.

THE Association of British Chemical Manufacturers sent to the President of the Board of Trade on November 1 the following memorandum, setting forth the views of the executive council of the association on the present situation in that section of chemical industry directly concerned with the production of dyes:—

(1) A wider and more comprehensive scheme of a completely national nature is immediately requisite if a supply of the colours, in variety and quantity essential to the conduct of our great textile industry, is to be forthcoming within a reasonable period of years, and especially with a view to the early elimination of all dependence on overseas supplies.

(2) The fundamental error which resulted in an inadequate policy in British dye production is the failure on the part of the originators of that policy to recognise the fact that the manufacture of dyes is not, by itself, an industry apart; but is precisely an integral part of, and is dependent upon, the operations covered by the chemical manufacturing industry as a whole—*i.e.* the manufacturer of heavy chemicals, of fine chemicals, of tar products, and of explosives have each and all separate functions to perform in developing a successful dye-producing industry in this country.

(3) The apparent failure to grasp the essential condition set forth in paragraph (2) has been the cause of the otherwise incomprehensible unwillingness on the part of the Governmental officials concerned to consult this entirely representative association of chemical manufacturers, and even to refuse the conference offered by an expert committee of the association some months ago.

(4) The general trend of what Lord Moulton said at Manchester in December, 1914, is correct when he pointed out that, broadly speaking, the manufacture of the greater proportion of essential intermediates should be conducted at the existing chemical works of the country, leaving the actual production of the finished colours to be in some measure centralised.

(5) No such comprehensive scheme has yet been formulated, with the result that firms capable of adding useful weight to dye production have had insufficient opportunity for doing so; and unless such opportunity is created, not only will time be lost, but unnecessary capital expenditure will also be incurred in the erection of plant which already exists in whole or in part at the chemical works of the country.

(6) The past and present schemes have not included the whole of the country's resources of knowledge in actual colour production; in short, there are potential dye-makers who have not been used sufficiently, and whose powers of production have not been developed to the extent of which they are capable.

(7) The problem of distributing to the best advantage the large sums of money recently voted by Parliament for the development of the dye industry is one upon which this association should advise. It is also felt that the questions of priority for the purchase of dye-making plant and the utilisation of materials are matters in which the wide knowledge of this association can be used effectively; and it is urged that unless measures of co-operation of this nature are adopted, the danger of duplication of plant and of overlapping in processes will be seriously increased.

(8) Unless co-ordinated action can be brought about to a much greater extent than is at present indicated, the problem of meeting external or overseas competition in peace-time will be more difficult and dangerous than is at present foreseen.

(9) The development of a British organic chemical industry, capable of keeping abreast of industrial achievements in the synthetic production of dyes, drugs, explosives, poisons, etc., is essential to the safety of the Empire. In this connection it is clear that the dye industry should be intimately co-ordinated with the other sections of organic chemical industry if the success of the whole is to be secured.

(10) To sum up, it is considered that:—

(*a*) An immediate co-operative effort is called for, and that a wider interest should be appealed to.

(*b*) The formation of those companies on which colour production will fall should not be confined in any sense.

(*c*) The whole chemical industry should be encouraged to assist, with both knowledge and money, an enterprise which is so vital to the maintenance and development of some of the country's most important industries.

As a consequence of this, the directing or controlling body should be representative, not only of colour-producing interests and colour users, but also of those other and equally important factors in chemical manufacture, the goodwill and assistance of whom are of paramount importance in the national effort which has become essential.

Sir Evan Jones, the Dyes Commissioner, to whom the memorandum was referred by the President of the Board of Trade, has replied to the secretary of the association that "full details of the scheme which his Majesty's Government propose to adopt for affording further assistance to the dye industry were presented to Parliament on the 6th inst. in the form of a White Paper, from which it will be observed that representation of your association on the Trades and Licensing Committee which is to be set up under the scheme has been provided for." This White Paper was summarised in NATURE of November 21. It appears that only one of the points referred to in the memorandum of the Association of British Chemical Manufacturers has been met, and that solely to the extent of the appointment of one representative of the association out of nine members of the Trades and Licensing Committee.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Saturday last, November 30, being St. Andrew's Day. The officers and other members of council whose names were given in NATURE of November 14 (p. 213) were duly elected. The address delivered by Sir J. J. Thomson, president of the society, is abridged below, and also the report of the council. Prof. Lorentz was unable to attend to receive the Copley medal awarded to him, and it was handed to a representative of the Netherlands Minister to be forwarded to him. Similarly, a representative of the French Ambassador received the medals awarded to Dr. A. Perot and Prof. C. Fabry. Dr. H. F. Osborn and Mr. I. Langmuir were also unable to attend in person to receive their medals.

ADDRESS BY SIR J. J. THOMSON.

With the cessation of the war, problems arise which are certainly no less difficult than those produced by the war itself. To repair the waste and heal, so far as possible, the wounds caused by the war, nay, even to be able to bear the burden of the vast debt which it has created, the country must produce on a much larger scale than it has ever done before. How is this to be brought about? The number of workers has been sadly diminished; the hours of work before the war were quite as long as is compatible with the health and happiness of the workers; in fact, no considerable increase in production seems possible with the methods in use before the war. I do not forget the magnificent contribution made by women to the work of the country during these years of stress, and it is quite possible that there may be a considerable permanent increase in the work done by women. There are few, however, who would think it satisfactory that women should bear through the long years of peace to which we look forward the heavy burden they have shouldered during the war, and no one would regard an increase in the burden on women as a tolerable solution of our difficulties.

But though the amount of labour cannot be very materially increased, it is certain that it can be made more efficient, and that with the same amount of labour more can be produced. This can be done by greater application of scientific methods to industry. It is gratifying that the Government realised the importance of this at an early stage in the war, and by establishing the Advisory Committee of the Privy Council for Scientific and Industrial Research created a department which is now organised and active, and to which we look forward with hope and confidence. But, for this work of reconstruction to be adequate, something more than the creation of a new department is necessary. Sympathy with, and an intelligent appreciation of, the importance of science in this work are required through all the Government Departments, civil and military, in the country. It is unfortunate that in these departments the number of permanent officials who have received the training which would ensure this appreciation is very small, and I venture to direct attention to the recommendation in the report of the Committee on the Position of Science in Education that steps should be taken to introduce into the Civil Service, at a later age than is possible on a scheme based solely on competitive examination, men who have had training in science and experience in research, and would be able to represent efficiently in the various offices this fundamentally important side of Government activity.

To give a training in science to all who will need it for the work of reconstruction will increase the strain on the universities at a time when some of them are faced with a difficulty which will soon become acute. In not a few of our universities, especially the older ones, the stipends of many of the teachers come from endowments which yield incomes of fixed value; but now, and there seems no chance of any immediate improvement in this respect, money has not much more than half the value it had before the war; the salaries of the teachers were certainly never excessive, they are quite inadequate under present conditions. In some way or other increased help must be given to the universities if they are to maintain their efficiency. To increase the resources and equipment of the universities would, I think, be the most effective way of aiding research in pure science. If the grants for this have to come from a fund which has also to provide those for industrial research, there is, I think, no inconsiderable danger that the latter may be regarded as the more urgent, and that the claims of pure science may be crowded out.

To pass on to another point, unfortunately we cannot yet assume that war will be impossible in the future, and that an army and a fleet are luxuries that we shall be able to do without. If our Army or our Fleet is to be effective, it must not be behind others in its equipment with the application of science to war. In the course of the present war, however, practically all such applications have been disclosed, so that all countries are at present in this respect on the same level, and unless we continue our researches we shall be left behind. The experience of the war has shown us the importance of science, and we have seen how the most unexpected and unexplored branches of science have furnished methods which have been of critical importance.

Now a large number of men with scientific training have been working during the war on the application of science to naval and military purposes; some of these have done remarkably well, and know the kinds of problems that have to be solved and the limitations imposed by service conditions. It would be deplorable if all this knowledge should be wasted. It seems to me most important to establish for each Service research departments for promoting applications of science to that Service. In the laboratories of these departments new methods would be sought for and investigated until their peculiarities were thoroughly understood; they would then be handed over to the technical departments of the Services, which would carry the thing from the stage of what might be called a piece of laboratory apparatus to that of an instrument which could stand the wear and tear of service conditions. They would also carry on experiments until the difficulties of manufacture had been so thoroughly overcome that this was a matter of routine. In peace-time it would not be necessary to manufacture in any quantity, but when war came and they were wanted they could be made without delay.

Officers in the Service with special scientific aptitude might at some stage or stages in their career pass some time in such a pioneering laboratory. This would not only improve their own knowledge, but also tend to diffuse a scientific spirit through the Service and make it more ready to welcome new ideas. But for this to happen I am convinced that each Service should have its own establishment. Many of the Services—the Navy, for example—would not, I feel sure, make much use of, or be much influenced by, large establishments for general scientific research, whereas if they had one which could be looked upon as an integral part of their own organisation it would, I think, have a good chance of success.

The Medallists.

The COPLEY MEDAL is awarded to HENDRIK ANTOON LORENTZ, For.Mem.R.S.

Lorentz is generally recognised as one of the most distinguished mathematical physicists of the present time. His researches have covered many fields of investigation, but his principal work deals with the theory of electrons and the constitution of matter considered as an electro-dynamic problem. When Zeeman had discovered the effect of magnets on spectroscopic lines, he perceived at once the theoretical bearing of the effect, which led to the discovery of the circular polarisation of the components of the lines split up by magnetic force. Lorentz's name is also associated with that of Fitzgerald in the independent explanation of the Michelson-Morley effect, from which far-reaching consequences have been derived. An important optical relationship between the density of a medium and its index of refraction (independently by L. Lorentz) was published in 1878, and he has been an active and fruitful investigator ever since.

A ROYAL MEDAL is awarded to PROF. ALFRED FOWLER.

Prof. Fowler's investigations have been, in the main, on spectroscopy, and one of his specialities has been the identification and reproduction of celestial spectra in the laboratory. His extraordinary success in identification of this kind is attributable in part no doubt to a special intuition, but also to a great and laboriously acquired knowledge of detail. For instance, the origin of the bands dominating the spectra of stars of Secchi's third class remained a mystery for many years. Fowler showed that they were due to titanium oxide. He accounted for many of the band-lines in the sun-spot spectrum by showing that they belonged to "magnesium hydride," and several other instances of scarcely less importance might readily be given.

Another important branch of his work is connected with spectrum series. The lines of many elements which appear in the arc spectrum have long been classified into series, and empirical relations have been obtained between the position of a line in the series and its frequency of oscillation. Those lines which are characteristic of the spark, and require higher stimulation, were not included in the scheme. Fowler was the first to show that the spark-lines form series at all. For this purpose he had first to work out experimentally the conditions for obtaining an adequate number of lines belonging to these series. Helium and magnesium were the elements chiefly studied. It was found that the spark-line series could be represented by formulæ similar to those which hold good for the arc lines, but with a fourfold value of the universal constant holding for the arc-line series of all the elements.

Apart from these investigations, leading to results so simple and definite, there is much descriptive work on spectra standing to the credit of Prof. Fowler and his pupils, which is highly appreciated by specialists for its accuracy and technical value.

A ROYAL MEDAL is awarded to PROF. FREDERICK GOWLAND HOPKINS.

Prof. Hopkins was among the very earliest, if not actually the earliest, to recognise and announce that minute quantities of certain bodies, the nutritive value of which had hitherto been unsuspected, exert an enormous influence upon growth and upon normal adult nutrition. He showed that without these accessory factors—vitamines—a diet otherwise full and seemingly complete is incapable of allowing growth, and even of maintaining body-weight or life. He has also made important researches into what may be styled the determination of the specific nutritive values of individual main components of the protein molecule; he has, for example, shown that when, from a certain diet which was proved to maintain nutrition satisfactorily, the two amino-acids, arginine and histidine, were together removed, the diet, though amply sufficient in energy and fully assimilable, failed to maintain life.

More recently Hopkins has attacked the question whether an animal's life can be maintained under the condition that, in place of protein or of the entire set of amino-acids constituting protein, a limited few of the several representative types of these constituents are provided in the diet. He shows that when, instead of the eighteen different amino-acids composing the protein, five only are administered, death rapidly ensues if those five be selected from the simpler aliphatic components, *e.g.* leucine, valine, alanine, glycine, and glutamic acid, but that, on the other hand, nutrition and life are satisfactorily maintained, at least for a considerable period, if the five amino-acids given be chosen from the more complex types, such as tyrosine, tryptophane, histidine, lysine, and cystine, which experiment has shown to lie outside the range of the synthetic power of the animal body.

The RUMFORD MEDAL is awarded to DR. A. PEROT and PROF. CHARLES FABRY.

MM. Perot and Fabry have introduced a new method of measuring wave-lengths by an ingenious method of utilising the luminous rings formed by interference between two reflecting plates. Their researches have proved of fundamental importance:—

(1) In comparing accurately the wave-lengths of different spectroscopic lines with that of some standard line.

(2) In comparing directly the wave-length of the standard line with that of the standard unit of length.

This comparison has confirmed in a remarkable way the previous measurement of Michelson, whose method is less direct and more liable to certain errors. The independent confirmation thus obtained has therefore placed the subject on a much firmer basis.

The DAVY MEDAL is awarded to PROF. F. STANLEY KIPPING.

Prof. Kipping has worked with distinction during the past thirty years on a great variety of problems connected with organic chemistry, involving fatty acids, derivatives of hydrindone, camphoric acid and its halogen compounds, the π-derivatives of camphor, racemism and pseudo-racemism, derivatives of quinquevalent nitrogen, organic compounds of silicon, including derivatives having optical activity due to the asymmetry of the silicon atom.

The DARWIN MEDAL is awarded to DR. HENRY FAIRFIELD OSBORN.

Dr. Osborn's chief work has been in palæontology, and, in connection with it, he has organised many collecting expeditions to the early Tertiary rocks of the West. One of the results of his work is the more precise determination of the relative ages of the extinct mammals in North America, and that has led to a correlation between the order of succession of the Mammalia in Europe and in America. A good deal of this work was summarised in his book, "The Age of Mammals in Europe, Asia, and North America," published in 1910. In 1900 Osborn had come to the conclusion that the common ancestors of Proboscidia, Sirenia, and Hyracoidea would be found in Africa; and the correctness of this view has since been confirmed by Dr. Andrew's discoveries in the Egyptian Fayum. Amongst the more important of Osborn's contributions to our knowledge of extinct Vertebrata are his memoirs on the rhinoceroses, the horses, the titanotheres, and the dinosaurs. In addition to all the work he has done personally, Dr. Osborn has had a wide and most beneficial influence upon biological research in North America, and he has produced a flourishing school of younger vertebrate palæontologists.

The HUGHES MEDAL is awarded to MR. IRVING LANGMUIR.

Mr. Irving Langmuir is a distinguished worker in the physics and methods of production of high vacua. He has studied the vapour pressure of platinum and molybdenum by heating fine wires *in vacuo* and noting the loss of weight. He has investigated the speeds of chemical reaction of different gases on various metals at very low pressures. He has investigated also the dissociation of hydrogen and its apparent abnormal heat conductivity, and the dissociation of chlorine and oxygen; also the chemical activity of dissociated hydrogen. His work on the emission of electrons from hot metals in high vacua led to the evolution of the "kenotron" and "pliotron," and of the "half-watt" lamp. His determination of the melting-point of tungsten is generally accepted. Much of his work, such as the investigation of the cause of blackening of tungsten lamps, is of commercial as well as of academic scientific value.

REPORT OF THE COUNCIL.

Several matters referred to in the report of the council have already been dealt with in these columns. Among these are the resolutions as to enemy aliens and foreign membership of the society, brought forward in June and July last, and the question of the future of international scientific organisations. The former matter was referred to the Inter-Allied Conference, held at the Royal Society in October last (see NATURE, October 17, p. 133, and November 14, p. 212), and it has been further considered by the conference which has just met in Paris. Other subjects dealt with in the report include the following:—

Bureau of Longitude.

At the request of the Admiralty the council has had under consideration a proposal that a body corresponding to the French Bureau des Longitudes should be established in this country, which should form an authoritative body to which any administrative questions involving scientific consideration of time or position could be referred. The following recommendations of a committee appointed by the council were forwarded to the Admiralty:—"(1) That the constitution of an advisory board such as that contemplated would present sufficient advantages to justify its establishment. (2) That the functions of the board cannot be so extensive as those of the French Bureau des Longitudes, or identical with those of the previous Board of Longitude in this country. (3) That it should be formed by representatives of various Government Departments and scientific societies, together with a few *ex-officio* members. (4) That it should meet not fewer than three times a year, and that some safeguard should be introduced preventing its meetings from becoming mere formalities. (5) That the exact definition of its functions should be left to further consideration by consultation." The Admiralty, being of opinion that it would be desirable to proceed with the proposal, suggested that representatives of the Home Office, War Office, Board of Trade, Board of Agriculture, Ordnance Survey, Royal Society, Royal Astronomical Society, and Royal Geographical Society should confer with the Hydrographer and the Astronomer Royal as to the establishment of the suggested board, and its functions if created. The council concurred in the proposal, and appointed Prof. Schuster to represent it at the conference. The matter is still under consideration.

Meteorological Office and Air Board.

At the beginning of the year the council was informed that a scheme was in contemplation for merging the Meteorological Office in the Air Ministry. The council approached the Treasury on the subject, pointing out that, while it appreciated the importance of extending the meteorological organisation so as to render it more effective in dealing with problems of aeronautics, the intimate connection of the science with agriculture, public health, and certain departments of the Admiralty, as well as with the general problems of geophysics, might, in its opinion, be endangered by handing over the Meteorological Office entirely to a department which necessarily concentrates its attention on a single branch of the work. As the result of a conference held in May last, the Treasury has agreed that it is not desirable to change the existing form of the constitution of the Meteorological Office, "which should remain, as in the past, the central institution devoted to the progress of the science of meteorology, and forming the focus for the activities of all departments interested in the various aspects of the science throughout the Empire." In view of the special interest in meteorology of the Air Ministry and of its great importance for the development of aeronautics and the problems connected therewith, the Ministry is now represented on the Meteorological Committee.

The National Physical Laboratory.

Important changes have taken place during the year under review in the relations between the society and the National Physical Laboratory. On April 1 last the transfer to the Department of Scientific and Industrial Research of financial responsibility for the laboratory took effect, and in the future the expenditure incurred in the work of the laboratory will be carried on the Vote of the Department.

While the normal extension of the scope of its work has been in many directions retarded or stopped by the war, in certain sections work already in progress has greatly increased in volume owing to the special conditions which have arisen, and during the past year it has been necessary to provide further accommodation for work of pressing importance. Three additional permanent buildings are, in consequence, at present in course of erection; two of these provide for extension of the aerodynamics researches and of the gauge work; the third will be devoted to the testing of volumetric glassware—largely made and tested in Germany before the war—and to work on optical instruments. The standardisation of scientific glassware is being carried on at present in temporary premises adjoining the laboratory. Temporary buildings have also been put up to accommodate other special war-work.

With the return of peace conditions provision must be made for the development of branches of technical research which hitherto, for lack of facilities, have received little or no attention. A scheme for the establishment of a National Electrical Proving House has been prepared by the committee of the Institution of Electrical Engineers. This provides that the proving house should be set up at the laboratory, and that a representative advisory committee should be appointed to assist the executive committee in its management. Proposals have been made that the laboratory should in some form undertake the responsibility for testing gauges and for other standardisation work in Birmingham. Similar proposals for the establishment of standardising laboratories have been brought forward in other centres of industry.

With the assistance of the Research Department, industrial associations are being formed to promote research and investigation in connection with important national industries. Research laboratories will, no doubt, be established at the principal centres of these industries working in immediate touch with associated manufacturing firms. Some of the work can best be done in the central laboratory more completely equipped for dealing with the more complex problems, and the laboratory has been invited in many cases to co-operate in the work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Lord Rothermere, who, as Sir Harold Harmsworth, gave 20,000*l.* for the endowment of the King Edward VII. professorship of English literature in the University, has now offered a like sum as an endowment fund for a professorship of naval history, to be called the Vere Harmsworth chair of naval history, in memory of his second son, who was killed in the Battle of the Ancre while serving with the Royal Naval Division.

LIVERPOOL.—The Vice-Chancellor, Sir Alfred Dale, has sent in his resignation, to take effect in September next year. In his letter to the President of the University Council he says:—"Our superannuation scheme, as you know, requires me to retire from my post in December, 1920, two years from now, but I am convinced that the University would suffer if I held on till then." The University Council, in accepting the resignation with regret, has placed on record its appreciation of Sir Alfred's invaluable services during nineteen years, first as Principal of University College, Liverpool, and afterwards as Vice-Chancellor of the University.

WAR conditions have depleted the technical schools in Germany, and the supply of trained engineers after the war is jeopardised. To meet this difficulty, a committee of engineers and manufacturers proposes (*Elektrotechnische Zeitschrift*, September 12) that special facilities should be given to students who renew their interrupted studies, and that the curricula and examinations should be modified to meet their requirements. Scholarships should be provided on a liberal scale to promising students. The Army should contribute to the relief of the situation by demobilising prospective students as early as possible.

A COPY of the report for last session, 1917–18, of the Faculty of Engineering of the University of Bristol, which is provided and maintained in the Merchant Venturers' Technical College, has been received. The number of tests on materials made for various industrial firms in the district in which the University is situated has grown very much in recent years. Some idea of the growth of this work of national importance may be gathered from the fact that in the department of civil engineering 53 tests were made during the session 1914–15, while during the session 1917–18 the number was 3661. As indicating the improvement in the general education of students taking up engineering, it may be stated that of the 102 day students, 83 are matriculated students of the University; the percentage of matriculated students is 81, as compared with 40 in the first session of the faculty.

THE trustees of the Carnegie Trust have sent a cheque for 300*l.* to the library of the Rothamsted Experimental Station for the purchase of important reference books. This is the second donation made by the Carnegie trustees to the library, a cheque for a like amount having been given two years ago. The purpose of their donation is to afford agricultural students and experts using the library the opportunity of consulting the most recent and important treatises on agriculture and allied sciences. Two other valuable gifts have been received, both from Capt. the Hon. Rupert Guinness. The library is fortunate in possessing an unusually good collection of early printed books on agriculture of the fifteenth, sixteenth, and seventeenth centuries. To these Capt. Guinness has now added perfect and beautiful copies of the first and second printed books on the subject, viz. the great volume on agriculture by Crescentius, printed in 1471 at Augsburg, and Jensen's edition of the Latin agricultural writers, printed at Venice in 1472.

THE following list shows the number of seats in the House of Commons of the University constituencies of the United Kingdom, and the candidates for them at the General Election on December 14. Representatives of the constituencies in the late Parliament are indicated by an asterisk:—*Oxford* (2): Mr. R. E. Prothero* (President of the Board of Agriculture), Lord H. Cecil,* Prof. Gilbert Murray, and Mr. H. S. Furniss. *Cambridge* (2): Mr. J. F. P. Rawlinson,* Sir Joseph Larmor,* and Mr. W. C. D. Whetham. *London* (1): Sir P. Magnus,* Mr. Sidney Webb, Mr. A. A. Somerville, and Sir Wilmot Herringham. *Wales* (1): Mr. Herbert Lewis* and Prof. Joseph Jones. *Northern Universities* (2): Mr. H. A. L. Fisher,* Sir Martin Conway, Mr. H. G. Williams, and Mr. J. A. Hobson. *Scottish Universities* (3): Sir Henry Craik,* Sir Watson Cheyne,* Mr. D. M. Cowan, Dr. P. Macdonald, Dr. J. Dunlop, Mr. T. M. Watson, and Prof. W. R. Smith. *Irish Universities.—Dublin* (2): Dr. A. W. Samuels* and Capt. Stephen L. Gwynn. *National:* Mr. J. P. Boland and Mr. J. MacNeill. *Queen's (Belfast):* Sir William Whitla.

AN abridged calendar for the current session has been issued by University College (University of London). It contains in a conveniently arranged form full particulars as to the courses arranged for students wishing to graduate in the different faculties of the University, details of the scholarships and exhibitions offered for competition, as well as a history of the college. In the various departments of science every encouragement is given to the study of the technical aspects of the science, in addition to the more academic side of the work. Thus, in the chemical laboratories courses are provided in applied chemistry and chemical engineering, the work being done in close co-operation with the department of engineering. Similarly, instruction is offered in the economic aspect of geology and in applied physiology, to name two of many instances. Every facility, too, is afforded to properly qualified students to take up original research in science under the guidance of the professors. The departments of civil and mechanical engineering—with sub-departments of graphics, surveying, and heating and ventilating engineering—and of electrical and municipal engineering provide students wishing to become engineers with a systematic training in the application of scientific principles to industrial purposes. The very complete arrangements described in the calendar should be studied by all persons who find themselves responsible for selecting a college for boys and girls entering upon university work.

THE council of the Sheffield Association of Metallurgists and Metallurgical Chemists appointed a committee last May to ascertain what educational facilities exist of interest and value to the association, and to recommend to the council any desirable modifications and extensions of such facilities. The committee has now issued a short report recommending that all students entering upon any specialised course of applied science should first have passed a general examination of matriculation standard. The report suggests that the present low status of assistant chemists can be traced to their not having received the amount of general education indicated by the examination, and recommends the council to endeavour to arrange for the provision of educational facilities in the evening with the view of remedying this defect. Assistant chemists who are not up to a matriculation standard in mathematics and experimental science are urged to qualify in these subjects so as to be ready to take up special courses in science and mathematics, which it is hoped to get arranged. This movement to secure for future workers in applied science a sound general education on which to build the superstructure of technical knowledge deserves every encouragement, and it may be hoped that the example of the Sheffield metallurgists will be followed in other industrial centres. The First School Examination recently instituted by the Board of Education for pupils of between sixteen and seventeen years of age in State-aided secondary schools should in a large measure ensure a good supply of youths suitably educated for later work in pure and applied science.

SOCIETIES AND ACADEMIES.

LONDON.

Optical Society, November 14.—Prof. F. J. Cheshire, president, in the chair.—**T. Smith**: Some generalised forms of an optical equation. The paraxial equation for refraction at a spherical surface $\mu'/x'-\mu/x=(\mu'-\mu)/r$ connecting the distances x and x' of conjugate points on the axis from the vertex may be made an exact equation for all rays by the inclusion of an additional factor. Any ray which intersects the axis is completely specified by two of three angles, α, γ, δ, some one of which vanishes when the rays are refracted without axial aberration. The angle α is the semi-angular aperture at which the ray is refracted; γ is the angle made with the axis by the line joining the centre of curvature of the surface to the intersections of the incident and refracted rays with the aplanatic surfaces; and δ is the deviation suffered by the ray. The correcting factor may be the product of the tangents of the halves of any two of these three angles. The form taken by the equation depends upon which pair of angles is selected.—**H. S. Ryland**: Notes on the design and manufacture of binoculars. The author discussed the faults which usually develop in binoculars from rough usage and ordinary wear; also the changes of design necessary to overcome them. It was shown that by small changes of design, the use of die-castings and press work could with advantage be developed. The more extensive use of moulded blanks for lenses and prisms was advocated, and the methods of moulding (or pressing) glass were described. Types of optical construction were shown, and it was suggested that "a three-piece cemented objective appeared to give a more brilliant image than those of the usual two pieces" construction, while, owing to the flatter curves, it was probably but little more expensive to produce. Various methods of adjustment were described suitable for use where instruments are, and where they are not, available. Finally, various methods of testing definite and light transmission were shown, including methods for the rapid comparison of binoculars with a measured standard.

Zoological Society, November 19.—Dr. A. Smith-Woodward, vice-president, in the chair.—Miss K. **Lander**: Method of preparing skeletons by the use of trypsin. A number of successful examples from the society's prosectorium were exhibited.—E. **Hatschek**: The forms assumed by drops and vortices of gelatin in various coagulants. A series of the formations was shown which simulated animal structures, and the author demonstrated the method by which he obtained his results.—Prof. F. **Wood-Jones**: A cast and a set of Röntgen-ray photographs taken from a chimpanzee belonging to the society. The animal had recently died from pulmonary tuberculosis, and attention was directed to the possibility of diagnosing tubercle in living subjects by the method described.—Dr. D. M. S. **Watson**: Seymouria, the most primitive known reptile.

Royal Microscopical Society, November 20.—Mr. J. E. Barnard, president, in the chair.—R. **Paulson** and Miss A. Lorrain **Smith**: Paper on microscopic preparations which were mounted during an investigation, in collaboration with Somerville Hastings, respecting the actual penetration of the living algal cells (gonidia) of a lichen by the fungal hyphæ. Reference was made to the papers of Schneider, Elenkin, Elfving, and Danilor in order to show that there was no agreement regarding the details of the penetration observed. Methods of fixing, staining, and mounting were explained. Bonney's was found most useful for differentiating alga and fungus, and for showing the various structures of the algal cell as the chromatophore, the so-called pyrenoid, and an eccentric body. Some slides illustrated the method by which gonidia increase in number, numerous daughter gonidia being shown within the mother-cells. The average diameter of gonidia was 12μ, and that of hyphæ 3μ to 4μ. During the whole progress of the work no clear case of penetration, and very few doubtful cases, were observed. Penetration of the living gonidia by fungal hyphæ occur so seldom that a theory of parasitism based upon its occurrence has very little evidence to support it.

Geological Society, November 20.—Mr. G. W. Lamplugh, president, in the chair.—R. H. **Worth**: The geology of the Meldon valleys, near Okehampton, on the northern verge of Dartmoor. The area dealt with lies between the London and South-Western main railway line, from a point a little east of Meldon viaduct to near Sourton, and the ridge of Dartmoor occupied by Black Tor, High Willhays, Yes Tor, and West Mill Tor, being the greater part of the valley of the Redaven and a portion of the valley of the West Okement. The southern extreme of this area is occupied by the Dartmoor granite, north of which are shales, in which occurs a patch of limestone, and these are intersected by numerous bands of igneous rock. The shales as a whole, with but slight local deviations, strike north-east and south-west and dip north-westwards, the mean angle of dip being about 50°. The sedimentary rocks are divisible into:—(1) An alumino-arenaceous series, extending from the granite northwards for a breadth of somewhat more than half a mile; (2) a calcareous series, abruptly but conformably succeeding the first; (3) a limestone, which occurs a short distance south of the railway; (4) radiolarian cherts a little above and a little below the horizon of the limestone; and (5) an aluminous bed north of the railway. In the sedimentary series planes of weakness have developed, the surface-traces of which are broadly coincident with the strike, but which frequently lie counter to the dip. These planes have been more or less successfully invaded by at least three series of igneous rocks, the order of which, commencing with the earliest, is as follows:—(*a*) A felsite with phenocrysts of micropegmatite, and quartz which shows good rhombohedral cleavage. (*b*) A series called the "dark igneous rocks." (*c*) Granitoid veins, subdivided into (1) the Meldon aplite and its associates, and (2) fine-grained granites of the ordinary Dartmoor type.

Linnean Society, November 21.—Sir David Prain, president, in the chair.—E. S. **Goodrich**: A fatherless frog, with remarks on artificial parthenogenesis. The author remarked on the artificial development of echinoderm eggs by special treatment into living examples, and that it had been found that frogs' eggs could follow a similar course. A female frog, carefully prepared to guard against previous impregnation, was employed, the eggs obtained by dissection were placed in rows upon glass slips, and punctured by fine glass needles of microscopic tenuity; blood was then applied, and the treated eggs placed in water. A certain number developed into tadpoles, and a few into complete frogs. It was found that the leucocytes in the blood were essential; the serum or ordinary red corpuscles were useless.—Miss Muriel **Bristol**: A review of the genus Chlorochytrium, Cohn. From investigations it appeared certain that the genera Chlorocystis, Reinh.; Stomatochytrium, Cunn.; Endosphæra, Klebs; Scotinosphæra, Klebs; and Centrosphæra, Borzi, were slight variations of Cohn's genus. Thirteen species were characterised in detail, and three doubtful species of Schroeter were mentioned.—A. S. **Kennard** and B. B. **Woodward**: The Linnean species of non-marine mollusca that are represented in the British fauna, with notes on the specimens of these and other British forms in the Linnean collection. There now seems some chance of approximate finality being attainable in the matter of nomenclature on the basis of priority—at least, in the case of the British post-Pliocene non-marine mollusca, with which the authors are particularly concerned. Accordingly, they are attempting a more thorough revision of their synonymy than was essayed by them in 1903 (*Journ. of Conch.*, vol. x., pp. 352–67) and 1914 ("List of the British Non-Marine Mollusca," 8vo, pp. 12).

MANCHESTER.

Literary and Philosophical Society, November 12.—Mr. W. Thomson, president, in the chair.—Capt. D. M. S. **Watson**: Biology and war. After referring to the use of much of the theory of natural selection in the apologies for militarism, and pointing out the confusion always present in the minds of those who so use it, the speaker referred very briefly to the various types of evolutionary changes exhibited by phylitic series of animals known from palæontological evidence, and pointed out that such evidence of this kind as is available suggests that natural selection has played only a very limited part in the actual progress which has occurred in animal structure.

DUBLIN.

Royal Irish Academy, November 11.—Mr. T. J. Westropp, vice-president, in the chair.—Mrs. L. **Porter**: The attachment organs of some common Parmeliæ. The author continues her investigations of the attachment organs of corticolous lichens by examining selected species of the Parmeliæ—viz. *P. physodes, conspersa, saxatilis, borreri, omphalodes, olivacea, caperata,* and *perlata*—and concludes that, except in the case of the first-named species, the organs are rhizines, *i.e.* strands of hyphæ holding the thallus more or less closely to the substratum; the rhizines, as a rule, expand at their apices into cup- or disc-like outgrowths, which may fuse to form a complete layer covering the substratum, and from which hyphæ may enter and disintegrate the bark.—R. W. **Evans**: Some types of cave formation. That limestone caves owe their origin to the enlargement of rock joints either by the solvent or by the mechanical action of water is a well-known fact. Either the one cause or the other may have been predominant in the formation of any particular cave. After reviewing the different types of cave formation Mr. Evans endeavours to show which of the above-mentioned forces has played the most important part in the special instances cited. Mr. Evans's examples of the types of cave galleries are almost entirely derived from Irish caves.

LEEDS.

Society of Glass Technology, November 20.—Mr. F. W. Branson in the chair.—W. J. **Rees**: Silica refractories for glassworks use. The author first outlined the various uses to which silica refractories could be put in glassworks, and dealt briefly with the provisional specification that is being set up by the Glass Refractories Committee. He next dealt with the raw materials required in the manufacture of silica bricks, etc., and the methods employed in this manufacture. He showed that the presence of iron in the form of magnetic oxide of iron was not detrimental to the properties of a silica brick. The lowest silica limit was put at 94 per cent., and it was shown that the presence of much alumina or more than 2 per cent. of lime was not advisable. Lime is certain to be a constituent of the silica brick, as lime slurry is used as a "bind." It is of interest to note that in some cases lime has a bleaching action, and masks any colour likely to be set up by the presence of iron compounds. Some users of silica bricks insist on a white or light-coloured brick, and reject dark-coloured reddish bricks. It has been proved that the colour of a brick is not the least criterion of its refractoriness. Silica bricks may be either coarse or fine in texture, but the texture must be uniform throughout. Coarse-textured bricks are better for withstanding sudden temperature changes, but they are worse from the point of view of attack by chemical fumes. Great advantage is gained in the manufacture of bricks if 25 per cent. of the materials are in the form of impalpable silica powder and the remainder in the form of grains with a maximum diameter of $\frac{1}{4}$ in.—J. H. **Davidson**, S. **English**, and Dr. W. E. S. **Turner**: The properties of soda-lime glasses. I., The annealing temperatures. A series of fourteen allied glasses had been made, beginning with a simple soda-silicate, and the effect of adding increasing amounts of lime on several of the properties of glass had been studied. The batches used were communicated, and the results obtained for the annealing temperatures. It was shown that the annealing temperatures increased with an increasing amount of lime. Increasing the lime percentage also improved the durability, and caused the glass to "set" more quickly. A batch for a bottle-glass was given, which showed little or no tendency to "crizzle," thus being different from the majority of soda-lime silicate glasses.

PARIS.

Academy of Sciences, November 4.—M. P. Painlevé in the chair.—H. **Douvillé**: The breccia of Salles and of Sère-Argeles.—H. **Parenty**: The genesis of a Cartesian agitation in a jet of steam of which the velocity is limited to the velocity of sound.—M. **Balland**: The rapid alteration of palm-oil. Palm-oil intended for consumption by colonial troops should be used as soon as possible after its preparation, since it undergoes a sort of spontaneous saponification which, after some months, prevents its use for culinary purposes.—Sir Philip Watts was elected a correspondant for the section of geography and navigation in succession to the late Lord Brassey.—E. **Gau**: The characteristics of partial differential equations of the second order.—P. **Sève**: Magnetic gear-wheels. Application to electric clocks.—A. **Sanfourche**: The Curie point in pure iron and ferro-silicons. The specially purified iron was melted in a quartz tube under a layer of boiling common salt, air and other gases being thus excluded. A mass of 80 grams of fused iron showed a point at 1310° C. on cooling, and 1365° C. on heating. These points were lowered by the addition of silicon, iron with 2·5 per cent. of silicon giving 1195° C. as the Curie point (cooling).—P. **Combaz**: The end of the glacial period in the Guiers valley and the Chartreuse massif.—A. **Nodon**: An electro-magnetic storm.—P. **Bertrand**: The great palæontological divisions of the Stephanian in the Loire basin.—E. **Gadeceau**: The submerged forests of Belle-Ile-en-Mer.—M. **Mirande**: A hydrocyanic acid-producing fern, *Cystopteris alpina*. The leaves of this fern contain a glucoside giving hydrocyanic acid by enzyme action. Benzaldehyde is also a product of the hydrolysis of this glucoside.—F. **Gaud**: Some points on the biology of the microfilaria.—S. **Marbaïs**: Specific vaccino-therapy in dysentery.—C. **Cépède**: A curative vaccine for pulmonary tuberculosis.—M. **Lespinasse**: The application of the Cépède method to the staining of the leprosy bacillus. This method gives results more rapidly and certainly than the usual Ziehl-Neelsen method.

November 11.—M. P. Painlevé in the chair.—Ch. **Barrois**, P. **Pruvost**, and G. **Dubois**: The passage beds from the Silurian to the Devonian in the Pas-de-Calais coal basin.—A. **Blondel**: The harmonic analysis of alternating currents by the resonance galvanometer.—Marshal Foch was elected a free Academician in succession to the late Léon Lobbé.—M. **Maggini**: A method permitting the simultaneous photography of stars in two different regions of the spectrum.—A. **Véronnet**: Constitution of the nucleus and atmosphere of the sun.—M. **François**: A method of estimating metals by electrolytic deposit without the use of external electric energy. The solution to be electrolysed is placed in a platinum crucible, and a rod of zinc or aluminium suspended in the liquid in such a manner as to be in metallic contact with the crucible outside the electrolyte. The arrangement forms a miniature battery. The method has been applied to the estimation of mercury, gold, and silver.—L. **Gentil**: The synchronism of the deposits and of the orogenic movements in the North Bætica and South Riffian Straits (southern Spain and Morocco).—C. **Nicolesco**: The genus Parkinsonia (generic characters, affinities, and species).—J. **Chaine**: Remarks on the metamerism of the Vertebrates.—C. **Cépède**: A curative vaccine for influenza. The vaccine is made from three species, Pneumococcus, Enterococcus, and Streptococcus, the exotoxins are removed by washing, and the colonies killed by thirty minutes' exposure at the boiling-point. Details of three cases are given in which the injection of the vaccine caused marked improvement.—R. **Douris**: Modifications of normal or syphilitic human serum under the influence of time.

MELBOURNE.

Royal Society of Victoria, September 12.—Miss Janet W. **Raff**: Abnormal development of the head appendages in the crayfish, *Parachaeraps bicarinatus*, Gray. The chief irregularity was in the position of the mandibles, these being situated at different levels, it thus being impossible for one to bite against the other. The antennæ and antennules also were abnormal in position.

BOOKS RECEIVED.

Hygiene of the Eye. By Prof. W. C. Posey. Pp. x+344+11 plates. (Philadelphia and London: J. B. Lippincott Co.) 18*s*. net.

The Wellcome Photographic Exposure Record and Diary (Northern Hemisphere and Tropics). Pp. 256. (London: Burroughs Wellcome and Co.) 1*s*. 6*d*.

Highways and Byways in Northamptonshire and Rutland. By H. A. Evans. With illustrations by F. L. Griggs. Pp. xv+367. (London: Macmillan and Co., Ltd.) 6*s*. net.

Annales de la Clinique Chirurgicale, du Prof. P. Delbet. No. 6. Biologie de la Plaie de Guerre. By Prof. P. Delbet and N. Fiessinger. Pp. v+460+iv plates. (Paris: F. Alcan.) 30 francs.

Hindu Achievements in Exact Science. By Prof. B. K. Sarkar. Pp. xiii+82. (London: Longmans and Co.) 1 dollar net.

The Evolution of the Earth and its Inhabitants. By J. Barrell and others. Pp. xi+208+iv plates. (New Haven: Yale University Press; London: H. Milford.) 10*s*. 6*d*. net.

Memoirs of the Geological Survey. England and Wales. The Water Supply of Essex from Underground Sources. By W. Whitaker and Dr. J. C. Thresh. The Rainfall. By Dr. H. R. Mill. Pp. iv+510+4 plates. (London: H.M.S.O.) 15*s*.

An Introduction to Trade Unionism. By G. D. H. Cole. Pp. vi+128. (London: The Fabian Research Department and G. Allen and Unwin, Ltd.) 5*s*. net.

The Payment of Wages. By G. D. H. Cole. Pp. vi+155. (London: The Fabian Research Department and G. Allen and Unwin, Ltd.) 6*s*. net.

Pioneers of Progress. Men of Science. Galileo. By W. W. Bryant. Pp. 64. The Life and Discoveries of Michael Faraday. By Dr. J. A. Crowther. Pp. 72. (London: S.P.C.K.) 2*s*. net each.

Forced Movements, Tropisms, and Animal Conduct. By Dr. J. Loeb. (Monographs on Experimental Biology.) Pp. 209. (Philadelphia and London: J. B. Lippincott Co.) 10*s*. 6*d* net.

The Origin of Consciousness. By Prof. C. A. Strong. Pp. viii+330. (London: Macmillan and Co., Ltd.) 12*s*. net.

On Society. By F. Harrison. Pp. xii+444. (London: Macmillan and Co., Ltd.) 12*s*. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 4.30.—Dr. C. Chree: Electric Potential Gradient and Atmospheric Opacity at Kew Observatory.—E. Nevill: The Value of the Secular Acceleration of the Mean Longitude of the Moon.—S. B. Schryver and Nita E. Speer: Investigations Dealing with the State of Aggregation. Part IV.—The Flocculation of Colloids by Salts containing Univalent Organic Ions.—Emil Hatschek: A Study of the Forms assumed by Drops and Vortices of a Gelatinising Liquid in Various Coagulating Solutions.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. Miles Walker: The Supply of Single-phase Power from Three-phase Systems.

LINNEAN SOCIETY, at 5.—Prof. W. A. Haswell: A Revision of the Exogonidæ.—C. D. Soar: Exhibition of Coloured Drawings of British Mites.—The General Secretary: The Tulbagh-Linné Correspondence.

CHEMICAL SOCIETY, at 8.

MONDAY, DECEMBER 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Sir Martin Conway: The Political Status of Spitsbergen.

ROYAL SOCIETY OF ARTS, at 5.—Prof. J. C. Philip: Physical Chemistry and its Bearing on Chemical and Allied Industries.

ARISTOTELIAN SOCIETY, at 8.—Prof. John Laird: Synthesis and Discovery.

WEDNESDAY, DECEMBER 11.

ROYAL SOCIETY OF ARTS, at 4.30.—Major-General Sir Frederick Smith: The Work of the British Army Veterinary Corps at the Fronts.

THURSDAY, DECEMBER 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Dr. M. C. Stopes: The Four Visible Ingredients in Banded Bituminous Coal.—H. C. Bazett: Observations on Changes in the Blood Pressure and Blood Volume following Operations in Man.

OPTICAL SOCIETY, at 8.—Instructor-Commander T. Y. Baker and Major L. N. G. Filon: An Empirical Formula for the Longitudinal Spherical Aberrations in a Thick Lens.—Major E. O. Henrici: Spirit Levels.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on Electric Welding.

FRIDAY, DECEMBER 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

No. 2563, VOL. 102] THURSDAY, DECEMBER 12, 1918 [PRICE NINEPENCE.

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THURSDAY, DECEMBER 12, 1918.

LICHENS: THEIR DESCRIPTION AND CLASSIFICATION.

A Monograph of the British Lichens. A Descriptive Catalogue of the Species in the Department of Botany, British Museum. By Annie Lorrain Smith. Part i. Second edition. Pp. xxiv+520+71 plates. (London: Printed by Order of the Trustees of the British Museum, 1918.) Price 30*s.*

THE need for a comprehensive descriptive work on British lichens has been increasingly evident during the last decade. This necessity was accentuated rather than satisfied when Miss Annie Lorrain Smith in 1911 supplied a second part to the "Monograph of British Lichens," the first part of which had been written by the Rev. James Crombie in 1894. During the intervening years so many advances had been made in our knowledge of lichens, and in the method of presenting such knowledge, that a revision of the first part of the monograph was absolutely essential. Crombie attached too little importance to the reproductive characters of the lichen, and consequently his system of classification was too artificial for present-day botanists. There had also been some reaction against the descriptive methods of his day, when lichenologists seemed to vie with each other in coining terms to express some infrequent phase of a lichen-organism.

In the second edition of part i. of the monograph an admirable attempt has been made to bring the work up to the standard of handbooks on other botanical groups, to classify the lichens in accordance with more modern views, to incorporate the discoveries of recent years, and to simplify the descriptions of the species. Another important improvement is the method of illustration. The sketchy figures given in the text of the first edition are replaced by seventy-one plates of drawings expressly prepared by Mr. P. Highley with his usual regard for both accuracy and beauty.

The introduction gives a short and simple account of the lichen-plant. Its chief fault lies in its brevity. The treatment is so excellent that an Oliver Twist attitude is engendered, and one wishes that a longer account had been given of such matters as the relationship between the algal and fungal constituents. This relationship is considered as symbiotic. Wallroth's and Elfving's views as to the parasitic nature of the fungus are not even considered worthy of mention. The symbiotic nature of the lichen-organism is generally accepted by lichenologists, and the fact that one symbiont (the fungus) occasionally preys on the other (the alga) is analogous to what has been shown by Keeble to occur in Convoluta.

The system of classification adopted is a wonderful advance on any system hitherto given in British works. Both symbionts are considered, the incomplete knowledge of phlogeny is requisitioned, and less attention is paid to the vegetative characters of the thallus.

The arrangement of the spores on basidia or in asci give the two sub-classes Basidiomycetes and Ascomycetes. Since all British lichens belong to the latter sub-class, it is the only one considered, and is divided into two series, Gymnocarpeæ with open apothecia, and Pyrenocarpeæ with perithecia. The Gymnocarpeæ are subdivided into three sub-series: (1) Coniocarpineæ with powdery apothecia or perithecia; (2) Cyclocarpineæ, having apothecia with open discs and fungal ancestors belonging to the Discomycetes; and (3) Graphidineæ, having apothecia with narrow discs, their fungal ancestors being allied to the Hysteriaceæ. The sub-series Cyclocarpineæ, with which part i. is mainly concerned, is next split up into orders according to the algal symbiont, the presence or absence of a thalline margin to the apothecium, and the form of the thallus, the relative importance assigned to these characters being generally in this sequence.

It is unfortunate that the name of order is retained for groups which, in accordance with modern views, ought rather to be called families. The retention of order cannot be altogether justified by the fact that this name was used for similar groups in part ii.

Some of the families have somewhat incongruous components if the views of sporologists have sufficient importance attached to them. Physciaceæ (unintentionally given as Physiaceæ on p. 189) includes Xanthoria and Placodium with colourless polarilocular spores, as well as Physcia with dark spores which are more 1-septate than polarilocular. Xanthoria and its allies would have been better placed as a separate family. Lecanoraceæ includes Lecanora, having eight simple spores in the ascus, Acarospora with many simple spores in the ascus, and Lecania and other genera with septate spores.

Owing to the different system of classification a long appendix is necessary to bring the work into conformity with part ii. In this appendix the species of Cladoniaceæ and Gyrophoraceæ are described, the members of the Sarcogyne section of Lecanora are rightly placed as Biatorellas, whilst Dirina, Roccellæ, Pyrenidium, and a number of species new to the British Isles are described under their proper families.

There is a considerable amount of alteration of names, mostly well-warranted according to the rules of priority. It is unfortunate that some well-established names suffer, and one could wish that the author had followed a similar course as that adopted for *Lecanora campestris*, the generally accepted specific name being retained, whilst the doubtful, though prior, name of *punctatus* was rejected. Other authors have considered themselves justified in rejecting some of the combinations used by Miss Smith, on account of their inappropriate or doubtful nature. *Synechoblastus rupestris* displaces *Collema flaccidum*, though many authors have considered the specific name of *rupestre* as of too doubtful priority to take the place of the well-established *flaccidum*. In *Leptogium microphyllum* the well-known specific name is altered to *fragrans*, a name which has been rejected by many authors on account of its inappropriateness, *Lichen fragrans* being merely an accidental fragrant state. It is difficult to understand why *aeruginosa* (Chænotheca, p. 8) displaces *stemonea*, since in the accompanying list of synonyms the first date assigned to *aeruginosum* is 1813, whilst that for *stemoneum* is 1810. Naturally there are many alterations in the status of a plant according to the personal views of the author.

For the distribution and frequency of the species too close a dependence is placed on the specimens in the Museum, and too little regard is paid to independent investigations. Cumberland is given as "the only British locality" (a phrase of too common occurrence) for the frequent *Pertusaria wulfenii* var. *rugosa*. *Lecanora pallida* (*albella*) cannot be considered "rather rare," and *Placynthium nigrum* form *triseptatum* is not "rare." *Schizoma lichinodeum* occurs not only on Ben Lawers, "the only locality," but also on the neighbouring Killin hills; and *Synalissa intricata* is found in more than one locality.

The iodine reactions for the Collemas are not always rightly stated; both *C. pulposum* and *C. multifidum* give a negative reaction, and not a reddish one.

The figure on p. xv represents a biatoroid rather than a biatorine apothecium. The spores of *Acarospora squamulosa* on plate 52 are given as almost spherical and approximately $7 \times 6\ \mu$, whereas the text (p. 333) rightly gives them as $8\text{–}12 \times 4\text{–}5\ \mu$.

Considering the magnitude of the work, such discrepancies are few, and the author can have the satisfaction of knowing that it is the most useful work on British lichenology which has hitherto been published. W. W.

IMPERIAL TELEGRAPH FACILITIES AND THEIR ADMINISTRATION.

Telegraphy, Aeronautics, and War. By Charles Bright. Pp. xvii + 407. (London: Constable and Co., Ltd., 1918.) Price 16*s*. net.

THIS volume comprises seventeen addresses and articles on inter-Imperial communication given before the London Chamber of Commerce, the Royal Society of Arts, etc., and contributed to the *Quarterly Review, Nineteenth Century, Empire Review*, etc.; seven memoranda upon aeronautics by the author, presented to Government Departments; and two popular lectures on the war. These three subjects are correlated, and their treatment, as it were, is brought up to date, in an introduction of seventy-four pages, which constitutes a valuable adjunct to the collection.

The chapters are all of substantial and practical interest—the forcible expression of the views of a man who thinks with a view to action. Taken together, the predominating impression that they give is that Mr. Bright is no pacifist as regards either the war or any subject of which he treats. He is so combative that, in reading, one almost feels constrained to lift one's arm to ward off a blow! You want him to be on your side! Then all is well and forcibly put, and there is a great mass of interesting and valuable matter clearly expressed.

Mr. Bright has devoted a large part of his life to the subject of cable communication, and his chapters on that subject cover the whole range—apart from technical matters, which he has sought to exclude. The paper reprinted from the *Navy League Annual*, 1911–12, on "The Importance of Inter-Imperial Telegraphy," is a strong plea that in such matters our Government should think imperially. In similar strain he draws a moral from the Atlantic cable system, urging that the allowance of the handing over of the control of British-made and British-owned cables, even to the United States, was unpardonable on any terms. Mr. Bright's long and strenuous advocacy of "All-British" cable routes for strategic reasons has certainly been amply justified during the Great War.

While one could not agree without demur to the whole of Mr. Bright's presentment of the scheme for "Administration of Imperial Telegraphs" (as, for example, where he fails to realise that the difference in profit from the working of the telephone system by the late National Telephone Co. and by the Post Office is due almost entirely to the substantially improved scales of pay awarded to the operating staff), it must be admitted that he shows a masterly grip of the general situation, and his concluding words about ourselves and the Colonies—"surely it is desirable that we should think together, act together, and, if necessary, fight together, in a common cause"—seem now to have more substantial reality than they could have had in April, 1914, when they were spoken.

It is a little surprising to find so independent a thinker tending to accept the popular view of the Civil Service. The Service is a *profession*, and you can no more make it "commercial" than you can make the Bar "religious," or the City "scientific." Those who know best realise that the new Government Departments—administered and controlled by "business" men, and infused with "business" ideals—present all the worst characteristics of the Civil Service, and few of its merits. The only distinctive merit of the new departments is that ignorance has permitted them to "kick over the traces"; but the enlightenment of only three or four years has gone a long way to neutralise that merit. If they are to extricate themselves from their entanglements, it will be years before they can be demobilised.

The Civil Service, which contains a fairly satisfactory proportion of men who possess real business ability (capable of "running" something much bigger than a 'bus!), must be diagnosed on quite different lines if its ills are ever to be effectively treated. Mr. Bright, however, evidently does to a very appreciable extent understand that the bigger a business becomes, the nearer its system of business and its relation to its staff approximate to Civil Service conditions—boards of directors do not differ essentially from Government Ministries, Boards, Offices, or whatever their title may be, except in the extent and bulk of the business controlled.

The book is certainly full of thought and of detailed information, and is good reading, inasmuch as it helps us to understand what important things we have left undone that we ought to have done. It is not too late to do them now.

A. J. S.

THE ART OF TRAVEL.

Handbook of Travel. Prepared by the Harvard Travellers' Club. Pp. 544. (Cambridge, Mass.: Harvard University Press, 1917.) Price 2.50 dollars.

THIS volume has been prepared by various members of the Harvard Travellers' Club in the hope of promoting intelligent travel and observation. Mr. G. M. Allen is the editor, while Prof. W. M. Davis seems to have been mainly responsible for the choice of authors. Books of this nature written by experts are not numerous, and though they appeal more to strenuous tourists than to serious travellers, they nevertheless have their uses, particularly in more technical matters. Observation is an attribute of most boys, but in later life it is hard to teach. American schooling probably does more than our own to develop it, but the Boy Scout movement, in its best phases, is its great nursery. The next generation of travellers may well prove more observant and not less resourceful than the last.

The first chapter, by Mr. W. B. Cabot, on "Camp and Travel in the North Country," is a fascinating account of woodlore and scoutcraft on the edge of civilisation, despite the author's irritating and ungraceful style. Chapters on tropical and arctic travel are useful and trustworthy guides. In the latter the pyramid-shaped tent, 6 ft. high, should be mentioned. The cover is supported by four bamboos meeting at the summit in aluminium sockets. The opening is a funnel, in the middle of one side, lashed after exit or entrance to exclude drift. The tent has the advantages of being light and of resisting any wind. During a blizzard it snows up and so is protected from both wind and snow. There are useful chapters on medicine and surgery and on determining positions. Dr. Hamilton Rice adds some notes on traverse surveys in South America. Among the other papers may be mentioned a very clear and instructive one on meteorology by Prof. R. DeC. Ward, and some condensed notes on geographical and geological observation by Prof. W. M. Davis. Prof. Davis describes the necessary mental equipment of a traveller as a moderate fund of geographical knowledge, an appropriate terminology, and a desire to do good work. This he thinks is sufficient for an empirical record of plainly visible facts. He does well to insist that care should be taken not to give a wrong impression by the use of inappropriate adjectives and of unnecessary superlatives. Florid language mars many records of travel.

The notes on natural history deal mainly with vertebrates and insects. More attention might well be paid to other invertebrates, since their collection is often neglected. It would be well to emphasise that fish are best preserved by fixing in formalin, and subsequent changes in graded strengths of spirit. A chapter on map-reading might be added. Elementary as such instruction may seem, it would prove useful, for few people, even if in the habit of consulting maps, are able to make full use of them. Cartography is not self-obvious, and, like other forms of notation, must be learnt. Some notes on scales and projections should certainly find a place in the book.

The volume has a compact, handy form which certainly enhances its usefulness. Most chapters have short bibliographies, some of which might with advantage be extended.

R. N. R. B.

OUR BOOKSHELF.

War Nursing. What Every Women Should Know. Red Cross Lectures. By Prof. C. Richet. Translated by Helen de Vere Beauclerk. Pp. xi+119. (London: William Heinemann, 1918.) Price 3*s*. 6*d*. net.

IT may be desirable that the nurse should have the scientific grounding outlined in this book, but to term it "War Nursing" is entirely a misnomer, for of the subject of nursing proper the book contains little.

Commencing with an introduction on the line of conduct of the nurse, the first chapter deals with antisepsis. The microbial basis of sepsis is discussed, and brief remarks are offered on the ideal antiseptic and on the antiseptic substances commonly in use. Anæsthesia is then considered from the physiological point of view, but no hints are given on the practical administration of anæsthetics. It is difficult to understand why this subject is included; either the nurse will not administer anæsthetics when it is unnecessary, or, if she does, practical details should have been given. The third chapter deals with foods—questions of calories and nutritive values—but, again, no details are given for feeding the sick.

Hæmorrhage is next considered, likewise with a similar lack of any practical instruction how to deal with an emergency hæmorrhage. In the two concluding chapters the subjects of fever and asphyxia are dealt with mainly from the physiological point of view, but why the last named should be included in a popular manual is difficult to understand.

A table of quantities—the carbohydrate and nitrogenous contents of foodstuffs and strengths of antiseptic solutions—occupies the last page. Here mistakes occur, *e.g.* solutions of carbolic acid 3 per 1000, and of boric acid $7\frac{1}{2}$ per 1000, are far too weak for practical use.

The book is really an introduction to medical physiology, and might be of service to one who desires to become a professional nurse, but is quite unsuited to the requirements of the "V.A.D." or emergency nurse. R. T. H.

The Student's Handbook of the University and Colleges of Cambridge. Seventeenth edition. Pp. vii+717. (Cambridge: At the University Press, 1918.) Price 6s. net.

THERE are three important additions to the present issue of this very useful handbook. First, the regulations for the new diploma in Oriental languages; secondly, the new regulations for the Classical Tripos and the Oriental Languages Tripos; and thirdly, the regulations for the newly established Nita King research scholarship to encourage research in the etiology, pathology, and prevention of fevers.

An account is also given of the new Parliamentary franchise for the University established by the Act of this year. The war has, of course, occasioned temporary emergency legislation on the part of the University authorities, and the various enactments are duly summarised.

Parents and intending students will find here all the information they seek concerning the University and the different colleges.

LETTERS TO THE EDITOR.

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

The Late Mr. R. P. Gregory.

IN supplement to Prof. Seward's sympathetic notice of the late Mr. R. P. Gregory in NATURE of November 28, I venture to add a few words as to the peculiar interest of his genetic work. Mr. Gregory was at first associated with me in the proof that the familiar heterostylism of Primulas is an allelomorphic phenomenon. He next undertook a laborious inquiry into the sex-polymorphism of *Valeriana dioica*, but, in spite of much experiment, the case proved intractable, and little positive result was reached. About this time he declined a lucrative post which would have, as he feared, meant the practical abandonment of research, and, undeterred by a rather disappointing experience, he attacked several problems met with in the genetics of *Primula sinensis,* to which he devoted his spare energies for many years. Mr. Gregory there encountered a group of facts of surprising novelty and importance, which were described in outline in Proc. Roy. Soc., 1914, vol. lxxxvii.B, p. 484. Certain plants known in horticulture as "giants" have all their organs of very large size, and two races of these are, as he proved cytologically, tetraploid, containing four times (forty-eight) the haploid number (twelve) of normal plants. Breeding from such plants, he found that they are actually endowed with four sets of Mendelian factors instead of the usual two sets proper to biparental inheritance. Various paradoxical consequences were, therefore, theoretically possible, and several of these, as he demonstrated, do occur.

Such tetraploid plants are known to have arisen *de novo* on two separate occasions (once in his own work and once at Messrs. Sutton's, to whom he was indebted for many facilities) from diploid parents, but, as Mr. Gregory discovered, they were incapable of breeding with the races from which they were derived —a fact hitherto unparalleled and indubitably of great significance. When war broke out he became involved in military duties, eventually going out to France and being rather badly gassed. For technical reasons the study of the "giants" had to be suspended, but he kept always in touch with the Primula work, which we maintained for him so far as possible. The purpose of the later experiments was to test the theory that the numerous linkages are indications of successive somatic segregations, a view to which he strongly inclined in preference to current interpretations based on cytological appearances, and he believed that support for the somatic theory was already in some measure provided by his own observations. He left a mass of records bearing on this question, which we hope eventually to publish, but the character and soundness of his work even in its imperfect state give it classical value. W. BATESON.

The John Innes Horticultural Institution,
Merton, S.W.19.

Cyclonic Circulation.

IN consideration of the theoretical or "gradient" wind associated with any system of isobars where the curvature of the path is taken into account, a point of some interest appears to have been generally overlooked in the past. In the steady state the equation connecting V, the velocity of the gradient wind, with γ, the pressure gradient, is $\gamma/D = 2\omega V \sin\phi \pm V^2 \cot\rho/R$, where D=density of the air, ω=angular velocity of the earth, ϕ=latitude, R=radius of the earth, and ρ=angular radius of the small circle which forms the path of the air at the time.

The positive or negative sign is to be taken according as the path is concave or convex to the low-pressure area. For any given pressure gradient and curvature of path there will be two roots for V from this equation—that is, two different velocities, real or imaginary, will satisfy the dynamical conditions. The interesting case where the roots are imaginary has been dealt with by Gold in his discussion of this question some years ago (Meteorological Office, Official Publication No. 190, 1908). In the ordinary cyclones and anticyclones with which we are familiar V has the value given by the smaller numerically of the two real roots, and the conditions pertaining to the larger root seem to have escaped attention.

To take a numerical example, let $\rho=3^\circ$ and $\phi=55^\circ$; then, adopting the normal value for the density D, the equation becomes $\pm V^2 + 40{\cdot}7 . V - 275\gamma = 0$ after conversion to the units m./sec. for velocity and mb. per 100 km. for pressure gradient. To deal first with the case of curvature convex to the "low," where the negative sign must be taken; putting $\gamma=1$ mb. per 100 km., the two roots for V become 9 and 31 m./sec. Both roots have the same sign, and correspond with clockwise rotation in the northern hemisphere. In this case (anticyclonic motion) the larger of the two roots does not seem to represent a stable state, and any perturbation would lead to a modification of the whole pressure distribution. This value is not, therefore, of practical interest. The lower value, 9 m./sec., is that which is met with in practice.

In the case of a path concave to the "low," the two roots for V are of opposite sign. The values corresponding with the above pressure gradient are V=6 and −46—that is, V=6 m./sec. for normal counter-clockwise rotation, and V=46 m./sec. for rotation in the opposite direction, *i.e.* clockwise in the northern hemisphere. The second, as well as the first, of these roots appears to represent stable conditions, and thus a depression revolving with high speed in a clockwise direction in the northern hemisphere is dynamically possible. In practice evidently such a condition could not get started on a large scale, as the rotation of the earth would inevitably cause the turning movement to commence in the normal direction. On a small scale, however, eddies round corners of houses or precipitous headlands might evidently be set up with revolution in either direction. It appears from the above that such rotation once started may, under favourable conditions, persist and develop into a dust whirl or tornado, with revolution either clockwise or counter-clockwise according to the direction of the initial impulse. One cannot impress too strongly on all observers of such phenomena the importance of noting in which direction the rotation is taking place. J. S. DINES.

66 Sydney Street, S.W.3, December 5.

Fuel Economisers.

WITH regard to the fuel economiser designed by Prof. C. V. Boys, and described in NATURE of November 28 (p. 249), I may mention that I have lately been making experiments in the same direction. In the arrangement tested by me the economiser consisted of a large rectangular metal box fixed over the upper part of the grate. The products from the fire were led by a horizontal flue above the fire into the lower part of the box, in which they ascended and heated it, after which they were drawn back to the chimney by a flue over the one by which they entered. The result was a considerable increase in the efficiency of the fire, but on removing the box to make some check readings under ordinary conditions it was found that the arrangement was impracticable. The flues were so coated with soot that it was evident that the box would require to be too frequently taken out for cleaning to make it worth adopting; and I fear Prof. Boys's arrangement will be liable to the same disadvantage. I should, however, mention that the coal used by me was not good, and was very smoky.

With regard to the objectionable appearance of these economisers, I may state that their appearance can be improved by painting them with suitable colours, as it is not necessary to use black. All paints—with the exception of aluminium—with which I am acquainted radiate equally well for heat of wave-lengths given out at the temperatures employed. White, or any colour, is as good as black for the purpose. The same remarks apply to colours with which hot-water radiators may be painted. The colour which harmonises best with their surroundings may be used without reducing their efficiency.

A great deal of the heat lost in the ordinary loosely fitted-in fire-grate might be saved if the fitting in was modified in the following way:—The bottom of the chimney is closed by a large sheet of metal, so as to make the fireplace-opening into a closed chamber; the grate is drawn forward two or three inches to allow of free circulation of air into and out of this chamber at the back of the grate, while the fire is provided with a chimney passing through the sheet of metal forming the roof of the chamber. By this arrangement the air heated by the hot back of the grate, which now goes up the chimney, would be sent into the room. In new grates it might be advisable to increase the amount of heat communicated to the grate by the fire, and also to increase the back surface of the grate by projections, flanges, etc. Great as the heat losses are in room-fires, it is admitted by all that it is our kitchen-ranges which are the great coal consumers and where improvement is most urgently called for. JOHN AITKEN.

Ardenlea, Falkirk, November 30.

THE trouble of cleaning referred to by Dr. Aitken has not in practice been found more than a minor inconvenience, and provision to make this easy is incorporated in the design. I agree with Dr. Aitken that, considering the radiating power alone, there is nothing in the colour, but it is desirable to employ an "enamel" stoved on so as not to smell if the temperature is raised, and I do not know that this can be done equally well with colour. While saving of fuel is most important and urgent at the present time, equable distribution of heat about a room has also its advantages, and it remains to be seen if this result brought about by my device will not itself more than compensate hereafter for the presence of the unobtrusive, if somewhat plain, heat interchangers—or "heavenly twins" as they were called by the first to benefit by their presence. C. V. BOYS.

A Mistaken Butterfly.

IN NATURE of September 5 last an Australian correspondent notes the attraction of the blue knob of a hatpin for a butterfly. When playing golf in Gulmarg (Kashmir) this summer I was frequently put off by a large butterfly settling on the ball just as I was making a stroke. I make a point of keeping my ball white and clean, and the butterflies evidently mistook it for a white flower. S. ROBSON.

Prince of Wales College, Jammu,
October 27.

CHEMICAL CORRELATION IN THE GROWTH OF PLANTS.

WHEN the apical shoot of a fir tree is broken off or injured, it is a familiar fact that one of the lateral branches below changes its direction of growth in order to take the place of the original apical shoot. The change of direction is accompanied by greater vigour of growth. These phenomena attracted the attention of Errera,[1] who suggested, as the reason why the lateral shoots do not tend to grow vertically while the apical shoot is intact, the possibility that the latter might produce inhibitory substances of a chemical nature which travel downwards to the other parts of the tree. Direct evidence was not then available, but the hypothesis has since received confirmation from certain experiments by Dr. Jacques Loeb, who appears to have been unaware of Errera's suggestion.

Although the phenomena are of general occurrence, Dr. Loeb found the tropical plant, *Bryophyllum calycinum*, an appropriate one for the purpose of investigation. The stem carries a series of buds, each in the axil of a leaf, while the leaves themselves are also provided with buds in notches around their edges. Under ordinary conditions all these buds are dormant. But they can be made to grow by various procedures. The common experiment of taking a willow shoot, cutting off the leaves and suspending it horizontally in moist

[1] Brit. Ass. Reports, 1904, p. 814. "Conflits de préséance et excitations inhibitoires chez les végétaux," Bull. soc. roy. botan. belgique, vol. xlii., 1904; reprinted in "Œuvres Physiol. Gén.," p. 101. (Bruxelles, 1910.)

air, can be repeated with this plant. It is found that the apical buds begin to grow first, while none of the others do so. The result, as pointed out,[2] may be explained in two ways: either a bud, when it begins to grow, sends out inhibitory substances towards the base of the stem, or the young growing bud absorbs the whole of some material requisite for growth. This latter explanation appears to hold in the case of the leaf buds, as will be seen later; but the following experiment shows that the former is the correct one for the stem: A piece of stem is laid horizontally. All the leaves are removed, with the exception of the two at the apical node, the petioles of which are left. So long as these petioles remain, the buds in their axils do not grow, but those in the next node below will commence to grow, and when the petioles have wilted and fallen off, the apical buds also begin to grow. Now, if the inhibiting effect of the apical buds on the more basal ones is due to the circumstance that those which grow out first take all the available supply of some necessary material, the buds in the node behind the apical one, since they grew out first, should continue to outstrip in growth those of the apical node which started later. If, on the other hand, the effect is due to an inhibitory substance sent towards the base by the growing bud, the most apical bud should soon outstrip those behind, because the apical buds send out inhibitory substances towards the next lower buds, while they themselves receive none. The actual result is in favour of the latter view. As soon as the petioles have dropped off, their axillary buds begin to grow, and not only rapidly outstrip in size those below, but even retard or stop their growth altogether.

If the effect is due to an actual chemical substance, the inhibitory effect should be in proportion to the size of the growing bud. It is scarcely possible to test this with the apical bud itself, but it can be done with the grown leaf, which also sends out similar material. This is carried by the sap which flows in the same half of the stem as that to which the leaf belongs. A stem is again laid horizontally, and all the leaves are removed except the two of the apical node. No shoots are produced so long as the leaves remain. If one leaf is removed, its axillary bud grows. The following experiment is then made: Twelve stems are taken, and all the leaves except one of the apical ones on each stem are removed, together with the free axillary bud opposite the leaf which remains. Six stems are placed with the leaf upwards, six with the leaf downwards. In the former case no shoots develop, except sometimes that in the second node behind the leaf, on the *lower side* only. In the latter case shoots develop either in the two lateral buds of the node behind the leaf or on the upper side of the second node behind the leaf. The interpretation is that the inhibiting substances, while flowing on the side of the stem where the leaf is, have also a tendency to flow downwards by gravity. If the stem behind the leaf contains only one node, no shoot grows, even when the leaf is below the node. A large leaf sends out a large enough mass of inhibitory substance to flood the buds. But if the leaf is reduced to one-tenth its size, then shoots are formed in the node behind the leaf. That the inhibitory effect of the leaf is not due to its withdrawing nutritive material from the stem is shown by the fact that the petiole left attached to a leaf remains fresh, but wilts if left attached to the stem without the leaf. The nutritive material is therefore sent by the leaf to the stem, not *vice versa*.

The fact that it is the apical bud that begins to grow first is given the following tentative explanation. When the leaves are first removed, the inhibitory substances are present everywhere, but continue to flow towards the base. Hence the most apical node is the first one to become freed from their presence, and when its buds grow they form anew the inhibiting substance which prevents the growth of the more basal buds.

No reference has yet been made to the collateral phenomena of the growth of roots. Observations were made on this point also, and indicated that the leaf sends out material which *favours* the growth of roots. This hormone may be the same as that which inhibits the growth of leaf buds.

In the earlier papers a number of experiments were described which indicate that the growth of the buds in the notches of the leaf is dependent on the amount of some material supplied by the leaf, since the growth is proportional to the mass of the leaf to which the bud is attached.[3] The part played by the direction of the currents in the leaf is also pointed out. The most recent statement of the author's results[4] is that the production of new shoots by a piece of stem is in direct proportion to the mass of a leaf left attached, and hence to the mass of growth material sent out by the leaf. The apex of an intact plant sends inhibiting substances, preventing the buds below from growing.

A theory of geotropic curvature is put forward,[5] in which the growth of the lower side of a stem placed horizontally is explained by the accumulation there of growth-promoting substances. The author[6] appears to hold that the assumption of a "stimulus" due to gravity is unnecessary. But there is experimental evidence that the perception of gravity is a separate phenomenon from the production of the curvature, so that the purely chemical effect by mass action would not be able to explain all the facts.

It should be noted that the production of inhibiting substances is a conception arrived at in the later stages of Dr. Loeb's work, so that some of the interpretations given in the earlier papers may require revision.

It is of interest that as definite a case of corre-

[2] "The Chemical Basis of Axial Polarity in Regeneration." By Jacques Loeb. *Science*, N.S., vol. xlvi., p. 547. (1917.)

[3] "Rules and Mechanism of Inhibition and Correlation in the Regeneration of *Bryophyllum calycinum*," *Botan. Gazette*, vol. lx., p. 249. (1915). "Chemical Basis of Correlation. I. Production of Equal Masses of Shoots by Equal Masses of Sister Leaves in *Bryophyllum calycinum*," *ibid.*, vol. lxv., p. 150. (1918.)

[4] "The Law Controlling the Quantity and the Rate of Regeneration," Proc. Nat. Acad. Sci., vol. iv., p. 117. (1918.)

[5] "Influence of the Leaf upon Root Formation and Geotropic Curvature in the Stem of *Bryophyllum calycinum* and the Possibility of a Hormone Theory of these Processes," *Botan. Gazette*, vol. lxiii., p. 25. (1917.)

[6] "The Chemical Basis of Regeneration and Geotropism," *Science*, vol. xlvi., p. 115. (1917.)

lation by chemical messengers between organs in plants as that found by Prof. Starling and the present writer in the case of the pancreatic secretion in animals seems to be made out.[7]

W. M. BAYLISS.

THE PREVENTION OF VENEREAL DISEASES.

THE Executive Committee of the National Council for Combating Venereal Diseases, of which Lord Sydenham is president, has put forth a number of proposals for meeting the danger of a large increase of venereal diseases among the civil population when the troops are demobilised. The *Times* of November 25, in commenting upon the recommendations, states that there will be about 300,000 infected men on demobilisation. These will be distributed to every part of the British Empire, carrying with them the germs of infection. Rural districts in Great Britain and in the Colonies which have hitherto been free or comparatively free from these diseases will consequently suffer seriously.

There are thirteen proposals of the Executive Committee for preventive and curative treatment, but here it is intended to deal with the third recommendation only, namely, "Some means should be devised whereby medical practitioners are encouraged to diagnose venereal disease in patients, and also to give early preventive treatment." The only meaning which can be attached to this solitary proposal for prophylactic treatment is that the patient, having exposed himself to infection, should (if and when the opportunity offers) apply to a doctor encouraged to diagnose venereal disease, who would tell him what course to pursue to eradicate the disease, or possibly what he might have done to avert infection in the past, or how to avoid it in the future.

Medical science has shown that the two venereal diseases, syphilis and gonorrhœa, are due to specific living germs, which when once they are implanted in the tissues of the body are extremely difficult to eradicate. It is too late in a number of cases to avoid serious consequences if the patient has to wait for a diagnosis even by an experienced practitioner, although modern improved methods of curative treatment can do much. If science be consulted rather than sentiment, the *earliest treatment* would be advocated, such as the use of germicidal disinfectants in portable form as soon after exposure as possible to kill the organisms before they can enter the tissues of the body. This prophylactic treatment was first shown to be effective by experiments on animals, and such a method of prevention applied to human beings, first publicly advocated in a letter to the *Times* by Sir Bryan Donkin, is supported by a great number of medical authorities. It has long been adopted by the Navy, and has recently been introduced by the Army.

In *Public Health*, the official organ of the Society of Medical Officers of Health (No. 12, vol. xxxi., September, 1918), there are some interesting and important articles proving the value of earliest treatment in the prevention of venereal disease. Space is too limited to give full details, but the following results speak for themselves: Capt. Walker, of the Canadian Medical Forces, at a conference in Paris, stated that before the introduction of earliest disinfectant treatment the incidence of venereal diseases amongst the 5000 officers and men on leave in Paris during August and September, 1917, was 20 per cent. From November, 1917, to the end of March, 1918, after the introduction of immediate disinfection, only 3 per cent. of infections occurred. Capt. Walker, from his experience, strongly urged (1) prophylaxis for men, (2) prophylaxis for women, (3) a separation of the moral from the medical side of the question.

Likewise the experience of Col. Elgood at Port Said, and of the Australian and New Zealand forces, shows that this earliest disinfection is the most efficient, though not *absolutely* efficient, method of preventive treatment, because neither drunkenness nor indifference and carelessness on the part of the individual can be controlled. The arguments against the application of this earliest treatment to the civil population are twofold: (1) The injury to the individual and collective moral sense; (2) the impossibility of inducing the local authorities to advocate its practical application. As to these points, we may remark:—

(1) It is doubtful whether the fear of contracting venereal disease quenches the fire of sexual passion of youth or makes the viciously inclined virtuous. Again, there is the sentiment that such measures advocated by public authorities would be an incentive to vice, but against this must be placed the misery and suffering to countless innocent women and children which would arise if an efficacious mode of prevention is rejected upon moral grounds.

(2) During recent times necessity, and alarm for the future of the race, have swept away many prejudices, and, therefore, it is not surprising to find that the Warrington Town Council by a resolution has advocated the adoption of this earliest treatment, and copies of the same were forwarded to the President of the Local Government Board and the councils of the county boroughs of England and Wales. Well may the official journal of medical officers of health, commenting upon this resolution, assert that as a practical preventive measure this is undoubtedly the most important step that has been taken up to the present.

WORK AT THE NATIONAL PHYSICAL LABORATORY.

SINCE the opening of the National Physical Laboratory in 1902 remarkable growth has taken place not only in its material resources of buildings and equipment, but also in the number of the staff employed. The Annual Report[1] recently

7 "The Chemical Regulation of the Secretory Process," Proc. Roy. Soc., vol. lxxiii., p. 310. (1904.)

1 The National Physical Laboratory. Report for the Year 1917–18. (H.M. Stationery Office, 1918.) Price 2s. 6d. net.

issued, in directing attention to this development, states that at the end of 1902 the staff numbered twenty-six, with one superintendent, in addition to the director. In July, 1914, the number had increased to 187. At the present time the staff numbers 532, with six superintendents (including the secretary) and nineteen principal or senior assistants. Nearly fifty members of the staff are on military service, and four have sacrificed their lives in the cause of right. The staff remaining is almost exclusively engaged on war work, including researches of a confidential character as to which but little can be written.

The increasing dependence of the country on applied science, for both war and commerce, has been emphasised by recent events, and as a natural corollary the laboratory, with some other institutions, has become nationalised. The property of the laboratory has been vested in the Imperial Trust for the Encouragement of Scientific and Industrial Research. This transference includes the William Froude National Tank, from which results of great value to the Admiralty have been obtained.

During the past year there has again been a considerable increase in the work of the laboratory. In particular, the laboratory has been asked by the Ministry of Munitions to undertake the manufacture of a certain class of gauges and to extend largely the provision for the testing of glass vessels for chemical work. For these two objects new buildings are required and are being provided. The number of munition gauges passing through the laboratory for testing purposes has approached 10,000 a week. In the Aerodynamics Department the demands grow daily, and the laboratory has been required by the Air Ministry to extend the accommodation, especially by the provision of additional large air channels.

It is only possible to refer briefly to one or two points of special interest in connection with the work of other departments. It is proposed that the custody and maintenance of the primary electrical standards of the Electrical Standards Laboratory of the Board of Trade should be assigned to the National Physical Laboratory, so as to avoid the continuance of dual systems of standards. Since the early part of 1917, when the supply of clinical thermometers was taken over by the Ministry of Munitions, it has been found desirable that each individual thermometer should undergo test, and more than 3000 clinicals have been tested per week. This work has necessitated the provision of three new clinical test baths, the capacity of each bath being approximately 600 instruments per normal day. Two new pantagraphs of simplified design have been constructed for the marking of satisfactory instruments. A card index record is made of all thermometers passing through the department. In the optics division, in addition to the large amount of routine testing carried out on behalf of the Ministry of Munitions, valuable work has been done in testing the refractive properties of optical glass and in simplifying the methods employed in the calculation and design of optical systems. The record of the laboratory affords overwhelming proof of the national importance of both pure and applied physics, and this must inevitably lead to more adequate recognition of the professional status of the physicist.

NOTES.

IN June last the Board of Trade, in co-operation with the Ministry of Reconstruction, appointed 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 announcement met with a cordial reception, for, with the exception of power installations at Kinlochleven, in the Scottish Highlands, and Dolgarrog, in North Wales, both for aluminium works, there is practically no utilisation on any appreciable scale of the natural water resources of the country, and the scope for development seems considerable. The names of the Committee commanded confidence. Sir John Snell is chairman, and, on the technical side, Sir Dugald Clerk, Mr. A. Newlands, and Mr. Philip Dawson are members; representatives of the Government and of the Associated Chambers of Commerce are also included. In the course of its investigations this Committee, which is still sitting, has found it desirable to delegate to a sub-committee its functions in so far as Ireland is concerned. Such a sub-committee has just been appointed by the Board of Trade, and it comprises Sir J. Purser Griffith (chairman), Dr. J. F. Crowley (vice-chairman), Mr. T. M. Batchen, Mr. G. Fletcher, Mr. L. J. Kettle, Lord Leitrim, and Mr. J. C. White, with Prof. H. H. Jeffcott as secretary. Although Ireland is not endowed to the same degree with favourable conditions such as those of the Highlands of Scotland, there are latent resources of water-power which are roughly computed by Mr. Newlands at between 200,000 h.p. and 350,000 h.p. These are to be found in connection with the great rivers which have a very considerable fall almost at the points at which they enter the sea. The reports of both Committees will be awaited with interest.

WHEN the British Scientific Products Exhibition was held by the British Science Guild at King's College, London, last summer, the hope was expressed that it would be transferred to great industrial centres in the provinces. Manchester promptly took steps to act upon this suggestion, and announcement can now be made that the exhibition will be opened at the College of Technology on December 27, and will remain open for a fortnight. The Right Hon. the Lord Mayor of Manchester is the chairman of the committee, and the detailed arrangements are in the hands of a strong executive committee, of which the principal of the college is chairman. The exhibition will follow the lines of that organised by the British Science Guild, but it will naturally be stronger in certain sections which represent industries centred in Manchester; in particular, the display of dyes and textiles is expected to afford a striking example of what British science and industry have been able to achieve in spite of war conditions, under the stimulus of the knowledge and enthusiasm of our scientific workers and manufacturers. Official exhibits will include a very striking collection of materials, models, and instruments used by and relating to the aircraft industry, which is being shown by the Aeronautical Inspection Department. The National Physical Laboratory, the Admiralty, and the Meteorological Office are also contributing departmental exhibits of high interest, and the Gas Traction Committee will show much the same collection which raised such interest at King's College. The other sections comprise heavy and fine chemicals, including drugs, food products, metallurgical products, glassware, and electrical, optical, thermal, mechanical, and surgical appliances. There will also be a representative exhibit of British natural products which have been exploited since 1914.

A WRITER in the *Times*, directing attention to the fact that a large number of Royal Air Force officers will shortly be demobilised, suggests that they might profitably be employed in making an aerial photographic survey of the British Isles. He believes that this would prove useful to surveyors, architects, engineers, and others. While fully endorsing this writer's opinion that it would be unfortunate to lose the expert services of these flying officers, many of whom are better trained than any future airmen can hope to be, we cannot agree that a series of aerial photographs could be of great service to surveyors and engineers. Such photographs show the landscape from a new point of view, but they naturally lack the accuracy of carefully drawn topographical maps. On the other hand, such a survey might be of considerable value in the progress of flying for commercial and other purposes. Many attempts have been made to devise suitable maps for airmen, but even the best available leave much room for improvement. A series of photographs, or, better still, several series taken under varying atmospheric conditions, would be of great help to the cartographer in constructing the type of map of use in flying. A number of experienced officers and men might well find employment in this work.

DR. R. T. LEIPER's investigations on Bilharziosis in Egypt and China, and those of various Japanese zoologists in Japan, have demonstrated the practical importance of the fresh-water molluscs as possible carriers of human disease. No indigenous species of Schistosomum, the Trematode parasite of Bilharziosis, is known to be commonly found in man in India, though sporadic cases of apparently autochthonous infection have been reported. The medical and sanitary authorities have, however, been prompt to recognise the danger of the introduction of *Schistosomum haematobium* into the country by means of infected persons returning from the front in Egypt or Mesopotamia. The Government of India has, therefore, instructed the newly constituted Zoological Survey of India to devote its attention to a survey of the fresh-water molluscs and their Trematode parasites. Dr. N. Annandale, the director, is studying the taxonomy, variation, and geographical distribution of the molluscs, and has commenced a series of tours to different parts of India proper and on the North-West Frontier, while Mr. S. W. Kemp is investigating the anatomy of the Cercariæ that infect the different species of water-snails and the possibility of infecting the latter with miracidia from the eggs of *Schistosomum haematobium*. Dr. F. H. Gravely is studying the life-histories of the molluscs, while Dr. Baini Prashad, formerly Superintendent of Fisheries, Bengal, has been appointed scientific assistant for the purpose of the whole inquiry. A generous grant of money has been made by the Indian Research Fund Association, and it has been arranged that the Zoological Survey shall work in the closest co-operation with the Indian Medical Service.

THE establishment of the Czech Republic, implying the severance of Bohemia and her neighbours, Moravia and Austrian Silesia, from the late Austrian Empire, has brought into prominence a race with remarkable gifts. Among men of science belonging to the Czech nation are the physiologist J. E. Purkyne, and a better-known name in England, the chemist Prof. Bohuslav Brauner, D.Sc. of Manchester. President Thomas G. Masaryk, lately in London, and now on his way to take up his duties at Prague, has long been known as a critical student of the English philosophers Hume, John Stuart Mill, and Spencer, besides Kant and Comte. Born in 1850, the son of Slovak parents, in Silesia, he began life as a blacksmith, but was soon able to cultivate his special gifts at Vienna and Leipzig. When the Czech University of Prague was opened in 1882 Masaryk was appointed professor of philosophy. From students we know that the standard required by him as an examiner is very high. Numbers of young men from Serbia and other Slav countries have passed under his influence. Prof. Masaryk's career has been that of a man of letters and politician rather than of a man of science, but as a sociologist he has written on suicide as a feature of modern European life, and on other social questions. A fearless investigator, Prof. Masaryk demonstrated that certain manuscripts purporting to be ancient Czech patriotic poems lately discovered, which were highly treasured and had found enthusiastic translators in many countries, were no more than adroit forgeries. In the notorious Friedjung trial of 1909 Prof. Masaryk conclusively proved that forged documents were made use of by the Austro-Hungarian Foreign Office. In December, 1914, he contrived to escape from Bohemia, where, like many of his colleagues, he must inevitably have suffered imprisonment, and has since championed the cause of Bohemian independence. Prof. Masaryk has lectured on Slav literature and sociology at King's College in connection with the School of Slavonic Studies. His inaugural lecture was on the problem of small nations in Europe. Both as writer and speaker President Masaryk is a thorough master of English.

INFLUENZA shows a further decrease in the number of deaths in London, the Registrar-General's return giving 942 for the week ending November 30. This brings the total deaths in London to 10,383 in the eight weeks of the epidemic. The deaths are still greatest at the ages of twenty to forty-five. Influenza has occasioned only 37 per cent. of the deaths from all causes in the week ending November 30, which is a lower rate than any previous week since that ending October 19, the percentage in the five weeks ending November 23 being respectively 47, 57, 57, 49, and 42. The epidemic is still very virulent in many country districts, and the returns for the ninety-six great towns of England and Wales, including London, show a slight increase in the number of deaths, many of the largest towns being less fortunate than London in this respect.

IN London the aggregate rainfall for the three months September, October, and November, which constitute the autumn, was, according to the Greenwich observations, 1·3 in. more than the normal. The excess was entirely due to the very wet September, when the rain measurement was 4·48 in. October had a deficiency of 1·2 in., and November a deficiency of 0·2 in. Rain was measured in London on twenty-five days in September, twenty-two days in October, and twenty-two days in November. The atmosphere throughout the autumn was generally humid, and the wind was drawn very greatly from the Atlantic. According to the monthly weather report for September, issued by the Meteorological Office, the weather was abnormally wet over the British Isles generally. In the West Riding of Yorkshire and in Lincolnshire, where the records extend over a period of more than fifty years, it was not only the wettest September, but wetter than any calendar month of the year. In many places rain fell every day. At Greenwich the mean temperature for each of the autumn months differs only a few tenths of a degree from the normal. The mean of the maximum and minimum temperatures for September was 57°, October 50°, and November 43°. In September the thermometer ranged from 73° to 38°, October 64° to 31°, and November 59° to 29°. September had six days with the thermometer above 70°, October seven days above 60°, and November thirteen days above 50°. There were seven nights in November with the lowest temperature above the monthly mean temperature for the twenty-four hours; two of these occurred in the closing week. The monthly weather report shows that September was generally cold over the whole country, and the temperatures on September 29 and 30 were in many places lower than any previously recorded in September. At Greenwich the duration of bright sunshine for the three autumn months was about six hours more than the normal, the sun registering for 162 hours in September, 78 in October, and 69 in November.

THE American Ornithologists' Union has elected Dr. Walter E. Collinge, of St. Andrews University, a corresponding fellow of the society in recognition of his investigations on economic ornithology.

PROVIDED an essay deemed worthy by the committee of award be received, the College of Physicians of Philadelphia will, on July 14 next, award the Alvarenga prize, value about 50*l.*, for a paper not previously published upon any subject in medicine. Competing essays must reach the secretary of the college, Mr. F. R. Packard, 19 South 22nd Street, Philadelphia, on or before May 1, 1919.

THE death is announced, in his seventy-first year, of Prof. Pierre de Peyster Ricketts, professor of assaying at Columbia University, New York, from 1885 to 1893, and from 1893 to 1900 professor of analytical chemistry and assaying. Since his retirement from the University Prof. Ricketts had been the head of a firm of mineralogical consulting engineers. In 1876 he published "Notes on Assaying," the first book on the subject to be adopted as a text-book throughout the colleges of the United States.

WE regret to note that the death of Mr. Frederick Edwards is recorded in *Engineering* for December 6. Mr. Edwards was born in 1848, and his death occurred on November 27. His name is well known in engineering circles as the inventor of the air-pump bearing his name. Hundreds of engineers have designed air-pumps since the days of Watt, yet that invented by Mr. Edwards marked a great advance on all that preceded it, and this result was attained by a simplification of parts which left men wondering why it had not been effected years before. Mr. Edwards, after varied experience, commenced practising as a consulting engineer in 1871, and continued to do so down to the time of his death. He was a member of the Institutions of Civil Engineers, Naval Architects, and Mechanical Engineers.

THE death of Mr. R. J. Pocock from influenza and pneumonia at Hyderabad Observatory on October 9 removes a most promising and energetic astronomer at the age of twenty-nine years. Born at Harlesden, London, on January 23, 1889, Mr. Pocock at an early age showed keen interest in scientific subjects, especially in astronomy, his mental faculties being encouraged and stimulated by his father. At the age of nine he went to Christ's Hospital, West Horsham, leaving there in 1908 with a scholarship at Queen's College, Oxford, where he greatly enhanced his mathematical reputation, obtaining First Classes in the mathematical school in 1909 and 1912. He then gave a year's work at the University Observatory for the B.Sc. research degree, and in the same year became the senior mathematical scholar. Evidently being marked out for an astronomical career, Mr. Pocock was appointed the director of the Nizamiah Observatory in 1914, with the definite object of assisting the Santiago (Chile) Observatory in completing the zone −17° to −23° for the International Survey. This involved the taking of 720 good negatives in −17° to −20°, and the consequent measurement and necessary reductions. At Mr. Pocock's death two of the zones (360 plates) had been finished and the results printed; the other plates had been so far completed that only 100 regions remained to be photographed and measured. This satisfactory result was the outcome of his own keen and energetic work, which instilled similar qualities in the Indian assistants. In addition to this somewhat tedious and absorbing work Mr. Pocock found time, in five years, to contribute fifteen papers to the Royal Astronomical Society (of which he was elected a fellow in 1914), four of which were read at the November meeting—a month after his death.

MR. E. A. MARTIN, president of the Croydon Natural History Society, has reprinted an interesting lecture on Anglo-Saxon remains in that neighbourhood. The earliest of these are a series of graves with cremated bodies found near Mitcham and Hackbridge. Near Mitcham have been found cases in which it is assumed that widows were immolated with their dead husbands. Interments in tumuli on Farthing Downs have provided some interesting artifacts. Near Thornton Heath railway station a stone coffin with a hoard of coins was unearthed. The local museum contains a fine collection of Saxon remains found at Croydon in 1894. Saxon occupation of the district is illustrated by a number of local place-names.

IN the *Scientific Monthly* (vol. vii., No. 5, November, 1918) W. La Rue discusses the problem of testing for intelligence, with special reference to the Army. The intelligence test is no longer of merely academic significance with the object of classification; it is not a museum arrangement of individuals that is the goal, but it is really necessary for practical purposes, since we are often now in the position of requiring to know what people will or can do in a given situation. The criterion of a test and of a tester is the possibility of predicting from the subject's behaviour with regard to the test how he will behave with regard to other problems. Just as we can prove a machine by testing its various parts, so may we test for intelligence. The alternatives are not laboratory tests *versus* no tests, but laboratory tests as against the casual test of individual opinion, which has many times been found to be fallible. In order that we may get more definite results, we ought to test, not only for general intelligence, but for special situations as well. The author maintains that the results of recent work done on these lines in the American Army are very promising. Although intelligence is not the only factor desirable in a soldier, line officers rating more highly obedience, adaptability, and dependability, yet from experiments it is found that if a man is placed according to his intelligence, he will be found to be placed substantially according to his camp value. The author believes that wherever there are problems of mental classification and of assignment to a person of the most suitable occupation, there the psychometrist will be of service.

MAMMALOGISTS will welcome the description of the mammals from the Korinchi country, West Sumatra, by Messrs. H. C. Robinson and C. Boden Kloss, which appears in the Journal of the Federated Malay States Museums (vol. viii., part 2, 1918), not only because it deals with the most extensive collection yet made in the island proper, but also because of the very careful way in which the work has been done. Six species are described for the first time, while a number of others, of which temporary diagnoses have already appeared, are now described in detail. Adults and young and variations attributable to age, sex, and season or to individuals are all carefully described, as also are differences attributable to altitude.

A DELIGHTFUL essay on the gannets of Bonaventure Island by Mr. P. A. Taverner appears in the *Ottawa Naturalist* (vol. xxxii., No. 2). Mr. Taverner describes the breeding colonies, not only of the gannets, but also of the guillemots, puffins, and petrels associated therewith. An attempt, he remarks, has been made to make this spot a perpetual bird reserve, but the efforts of the Conservation Commission in this direction have met with only a cold response from the local population. It is to be hoped that the Dominion authorities will not relax their efforts in this matter, if only to put an end to the wanton destruction caused by "sportsmen" who seem to take a delight in slaughtering the birds without making any use whatever of their victims, which include thousands of young left to die of starvation by the death of their parents.

THE peach-shoot borer (*Laspeyresia molesta*, Busck.) causes considerable damage to peach-trees, as well as to other rosaceous trees, in Japan. An interesting account of the biology of this insect is given by Messrs. Harukawa and Yagi in the *Berichte des Ohara Institutes* (Bd. i., Heft 2, pp. 151–70). On the south coast of western Japan this insect passes through five generations in a single year, but the number of annual generations appears to be determined to a greater or less extent by the climatic conditions. The duration of the egg stage was found to be 2–4 days, of the larval condition 11–15 days, whilst the insect remained in the pupal state for 6–10 days. At the onset of cold weather the larvæ spin their cocoons, pass the winter as caterpillars, and only assume the pupal state the following spring. The young caterpillar, as soon as it leaves the egg, makes its way to the base of a still unexpanded leaf of a young shoot of the peach-tree, bores its way into the pith, and destroys this from above downwards. The insect also attacks the fruit of the peach, pear, etc.

RADIO-METALLOGRAPHY is the subject of a short article by Mr. Thorne Baker in the *British Journal of Photography* for November 29. By using a modern high-tension transformer and Coolidge tube, heavy currents of extreme penetrating power can be produced, and render it possible to take photographs through 4 in. of hard steel. A hole 1/64th of an inch in diameter and of the same depth, drilled in the upper surface of a block of steel 2 in. thick, will show distinctly in a good radiograph with an exposure of about two minutes, so that the usefulness of the method for showing flaws and cavities is very promising. Installations for testing by this method have been put up by many large engineering firms. The protection of the operator is a rather different problem from that in ordinary medical work, and it is preferable to control the apparatus from a separate room or cabin, the partition being lined with heavy sheet-lead, a thick lead-glass window being provided, and covered with a lead shutter immediately the tube is seen to be acting properly.

THE subject of the Traill-Taylor lecture, which was delivered this year by Mr. F. Twyman, of Messrs. Adam Hilger, Ltd., was "The Use of the Interferometer for Testing Optical Systems." A full account of the lecture is published in the Journal of the Royal Photographic Society just published (November). Mr. Twyman's experience confirms Lord Rayleigh's rule (which was derived from the calculations of light intensity distribution for a few specific cases) that an optical instrument cannot properly be described as of first quality if it produces aberrations greater than a quarter of a wave-length. Many photographs of interference patterns produced by aberrations are given in the report. In order to utilise the result of the test, the contour lines of the pattern are marked during the observation on the surface of the lens with a paint-brush, and then the part indicated as the highest is polished off, gradually extending the area of polishing to the further contour lines. Mr. Twyman says that this is "not at all a difficult or very lengthy operation, and one which I have performed this morning, before my usual breakfast-hour, on a very similar lens." We are therefore justified in hoping that the near future will enable us to get optical systems much nearer to perfection than those to which we have been accustomed, without any notable increase in their cost.

THE importance of kinematograph propaganda has been fully realised by America and Germany, and it is quite time that its usefulness was appreciated in England. As the Industrial Publicity Service, Ltd. (Hampden House, Kingsway, W.C.2), points out in a recent brochure, 90 per cent. of the films shown to the British public are of foreign origin, with the result that the conceptions of life which a multitude of our people derive are those as represented principally in America. Among the objects of the Industrial Publicity Service (which is a non-profit organisation controlled by various manufacturers' associations) are that it should serve as a medium by which the general public at home and abroad should be better informed of the development of British industries through the Press, and that it should organise kinematograph displays, etc., showing the importance of improved methods of production on the well-being of the population. In this respect the claims of British science as applied to industry should receive attention, so that other nations may realise, through the medium of the kinema, what Britain has accomplished in that direction. If this method of propaganda were judiciously resorted to, it would go far to maintain the prestige of the British nation among our Allies and neutral countries. The main thing is to make films of this kind popular and interesting, and it could be done without detracting in any way from the dignity of science.

IT is well known that American shipbuilding yards have made extensive use of bridge-building and other suitably equipped works for the fabrication of parts of vessels. Similarly it was necessary to utilise for the propulsion of ships so built every type of standard engine which could be said to be in any way suitable for marine work. From an article in *Engineering* for November 29 we learn that American ships are being equipped with almost every known type of oil-engine, utilising in consequence in the case of several types various means to reconcile conditions of maximum propeller and engine efficiency, such as mechanical gearing and electric transmission. The powers so far are relatively small, 200 h.p. per cylinder being the maximum recorded. In one case the main Diesel engines are of the Willans and Robinson type, with six working cylinders 12 in. by 18 in., and develop 320 b.h.p. at 250 revs. per minute. This speed is reduced by gearing to 100 revs. per minute at the propeller. This method has a number of advantages in the application of Diesel engines to marine propulsion. The problem is not quite analogous to mechanically geared turbines, and the question of the ability of mechanical gearing to stand up to its work under conditions of uneven turning moments is the principal one that can be raised in connection with this application of gearing.

THE latest catalogue (No. 176) of Messrs. W. Heffer and Sons, Ltd., Cambridge, gives particulars of upwards of 1300 works dealing with a variety of subjects. Many of the books offered for sale are first editions, and not easily obtainable. The section devoted to science and mathematics is not lengthy, but the catalogue is worthy of the attention of readers of NATURE because of it and that headed "Books for Librarians." In the former section we notice long runs of *Biometrika*, the British Association Reports, the *Conchologist*, the *Philosophical Magazine*, vols. i. to xcii. of NATURE, and complete sets of the Proceedings of the Physical Society of London and the Proceedings of the Royal Society of Medicine. In the section of "Books for Librarians" are to be found a complete set, to 1914, of the *Journal of Physiology* and long series of the Journal of the British Astronomical Association, Memoirs of the Royal Astronomical Society, the Journal of the Royal Geographical Society, the *Geological Magazine*, the Journal of the Royal Microscopical Society, and the Proceedings and Transactions of the Zoological Society of London. The catalogue will be sent free upon application.

THE next volume to be published in *Messrs. Constable and Co.'s* "Staple Trades and Industries" series will be "Tea," by D. Hunter. Other volumes are in preparation. *Messrs. Henry Frowde and Hodder and Stoughton* announce "War Neuroses and Shell Shock," Lt.-Col. F. W. Mott, illustrated; "Orthopædic Effects of Gunshot Wounds and their Treatment," Capt. S. W. Daw; "Medical and Surgical Aspects of Aviation," H. Graeme Anderson; "The Anatomy of the Peripheral Nerves," Lt.-Col. A. M. Paterson; and "The Early Treatment of War Wounds," Col. H. M. W. Gray. *Messrs. Heinemann (Medical Books), Ltd.*, will publish shortly "Pensions and the Principles of their Evaluation," Drs. Ll. J. Llewellyn and A. Bassett Jones. *Messrs. Longmans and Co.'s* new list includes "Naval Architects' Data," J. Mitchell, edited by E. L. Attwood; vols. ii. and iii. of "A System of Physical Chemistry," Prof. W. C. McC. Lewis; vol. i. of the third edition of "British Birds," written and illustrated by A. Thorburn; and new editions of "Recent Advances in Organic Chemistry," Dr. A. W. Stewart, and "Dental Surgery and Pathology," J. F. Colyer. *Messrs. Witherby and Co.* announce the publication, in serial form, of "De Vogels van Nederland," by Dr. E. D. van Oort. The work will be issued in forty parts, and contain four hundred coloured plates. It will be written in the Dutch language, with the scientific names given, in addition, in English, French, and German.

OUR ASTRONOMICAL COLUMN.

DWARF STARS.—In the course of an article which appears in the November issue of *Scientia*, Dr. A. C. D. Crommelin discusses the evidence which suggests that dwarf stars are the most numerous class of stars in space. Such stars, which are to be regarded as small in volume rather than in mass, may comprise about three-fourths of the total number of stars, but only a few of them are known, because at a very moderate distance they become too faint to be included in our star catalogues. As examples of dwarf stars, Barnard's runaway star in Ophiuchus and the "Proxima Centauri" of Innes are described in detail. Barnard's star has a proper motion of 10·3″ per annum and a parallax of 0·525″, and is unique as being the only star having a proper motion which is sensibly increasing as a result of diminishing distance. The velocity of approach is about 100 km. per second, and this would cause the annual proper motion to increase by 0·10″ per century, which is in satisfactory agreement with the available observations. The spectral type of the star is M*b*, and its luminosity 1/2000 that of the sun. From its high speed a small mass is probable, and if the star be assumed to have a mass one-eighth that of the sun, and a somewhat greater density, the surface brightness would be 1/170 that of the sun.

THE SUN'S ROTATION.—The application of the spectroscopic method to the investigation of the sun's rotation has led to such different results as to have suggested to several observers that the rate of rotation must be variable. Mr. R. E. De Lury, however, has maintained for some time that the differences in the results are not of solar origin, but arise from varying amounts of atmospheric haze, which superposes an unmodified solar spectrum on the displaced spectra at the solar limbs. He returns to the subject in a further discussion of the observations made at Ottawa (*Astrophys. Journ.*, vol. xlviii., p. 195), and concludes that there is at present no sound reason for believing that the rate of the sun's rotation is variable. In general, high values of the rotation were obtained during brighter conditions, and low values during hazier conditions. Thus the low values of rotation obtained by Evershed and Royds in 1912–13 may well have been due to the haziness produced by the Katmai eruption in June, 1912, which also caused a great reduction in the measured values of the solar radiation.

THE CANADIAN 72-IN. REFLECTING TELESCOPE.—The great reflecting telescope which has been erected by the Canadian Government on Observatory Hill, near Victoria, B.C., has been finally completed by the installation of the optical parts, and is now in regular successful operation. Further interesting details of the instrument are given by the director, Dr. J. S. Plaskett, in a communication to the Journal of the Royal Astronomical Society of Canada (vol. xii., p. 399). The disc of glass, 73½ in. in diameter, about 13 in. thick, with a central hole 6 in. in diameter, and weighing nearly 5000 lb., was successfully cast and annealed at the works of the St. Gobain Glass Co., in Charleroi, Belgium. It was completed in July, 1914, and was fortunately shipped from Antwerp about a week before the declaration of war. The grinding and figuring of the mirror to a focal length of 30 ft. was carried out by the Brashear Co., at Pittsburgh. The maximum deviation of the final curve from theoretical perfection amounted only to about one-eighth of a wave-length, or double the accuracy required by the specifications. The secondary mirror for using the telescope in the Cassegrain form is 20 in. in diameter. The mounting of the telescope is of the "English" pattern, and permits the observation of all parts of the sky. It is satisfactory to find that the performance of the optical parts, the mounting and the dome, and the character of the seeing are quite equal to, and even exceed, expectation. With the single-prism spectrograph now in use excellent spectra of stars of photographic magnitude 7·0 are secured in about twenty-five minutes, and the change from one star to another can be made in less than five minutes. Canada is to be congratulated on having obtained so fine an instrument for astronomical research.

THE EDUCATION ACT OF 1918 *AND ITS POSSIBILITIES.*

THE Education Act, which received the Royal Assent on August 8, contains within it potentialities of the highest moment for the well-being of the nation, and only needs goodwill and a progressive spirit to realise to the full the ideals of its chief promoter. On the same day that it became law the Board of Education put into legal effect thirty-three out of the fifty-two sections which comprise the Act, some of them of considerable importance as paving the way for the more revolutionary changes which the Act is ultimately designed to accomplish.

The chief sections made immediately operative are intended (7) to remove the limitations as to expenditure from the rates by the council of a county for the purposes of education other than elementary; (8) to empower the education authority to require the attendance of any child at special classes or courses of practical instruction or demonstrations held in other than the school buildings; (15, 16) to enable the authority, upon the report of the medical officer, to prohibit the continued employment of a child, or to alleviate its conditions, where it is shown to be prejudicial to the health and physical development of the child, and to impose penalties on an employer for breach of its by-laws; (17) to authorise the authority to maintain, or to aid the establishment of, school camps, centres, and equipment for physical training, playing fields, school baths and swimming baths, and other facilities for social and physical training in the day or evening; (18) to extend the provision of medical inspection and treatment to other than elementary schools so as to include secondary and continuation schools and other schools and institutions provided by the education authority; (19) to provide or aid the provision of nursery schools for children between two and five years of age, or to a later age, so as to ensure the health, nourishment, and physical welfare of such children; (21, 24) to make suitable provision, inclusive of board and lodging, so as to enable children in exceptional circumstances, such as the remoteness of their homes, or other special conditions, to receive the full benefit of efficient elementary education, and to make agreements with the parents accordingly, and to provide, in addition to scholarships for higher education, allowances for maintenance; (23) to empower the education authority to aid research with the view of promoting the efficiency of teaching and advanced study, and of aiding investigation for the advancement of learning; and (34) to acquire land compulsorily for educational purposes, substituting the authority of the Board of Education for that of the Local Government Board; and, further, (35) to provide a public elementary school immediately outside its area for the use of chidren within its area.

A very important provision is made in sections 45, 46, and 47 whereby by an Order in Council the Crown can appoint an official trustee or trustees of educational trust property, which property is relieved of the restrictions imposed by the Mortmain Acts, and its control is now vested in the Board of Education and differentiated from all other charitable trusts. The removal of the limitation in the Act of 1902, whereby the council of a county shall not exceed in its expenditure in respect of higher education a sum out of the rates exceeding *2d.* in the pound—a provision the reason for which it is difficult to understand, seeing that the county boroughs had unlimited powers—will enable the more progressive among these authorities to make much more extensive provision for advanced education; to provide efficient and accessible secondary and special schools in rural areas; to increase the number of scholarships and the means of maintenance, since no child is to be debarred from receiving the benefits of any form of education by his inability to pay fees; to secure due facilities for medical inspection and treatment for children and young persons in secondary and in continuation schools; and to provide all desirable means and opportunities for ensuring social and physical training among those pursuing the various branches of higher and continued education. Already the more advanced and enterprising of the county authorities are busy considering schemes of educational development with a view to their immediate application.

The mandatory powers now assured by the Act to the Board of Education will enable it to require from all local education authorities the provision of schemes for the development and comprehensive organisation of education within their areas, to which, when approved, it shall be the duty of the several authorities to give effect. This marks a great advance upon the Act of 1902, which in this regard was largely permissive in its requirements, of which many laggard authorities took advantage.

The provision of nursery schools will ensure a very large saving of infant life and a much more vigorous child-population, since the children in poor and crowded districts, especially in the industrial areas, will be better fed and cared for and their infantile ailments dealt with effectively. Nor will the medical inspection and treatment of the adolescent in the continuation schools be less beneficial, securing as it will, at a critical period of life, that desirable attention to the health and vigour of the body which will ultimately ensure a much higher standard of virility in the adults of the nation. There is abundant evidence since the advent of the war of the avoidably large percentage of the youthful population who are far below a satisfactory standard of health and vigour arising from neglect in childhood and early youth.

So soon as the Act comes into full operation (which, judging by the course of events of the present war, may happily be within a few months), half-time, which prevails mainly in the textile districts of Lancashire and Yorkshire, and all other exemptions enabling children under fourteen years of age to leave school, will be abolished. Provision is made in the Act for a large extension of the sphere of the elementary school, fees in which are abolished. Central schools may be established in which at appropriate stages practical instruction suitable to the ages, abilities, and requirements of the children must be set up. Courses of advanced instruction for older pupils desirous of remaining at school beyond fourteen years of age must be provided, and measures taken for the preparation of children who desire further education in schools other than elementary and for their transference thereto.

Provision must be made for a sufficient supply of continuation schools, free of all fees, for young persons between fourteen and eighteen years of age who are in employment, the instruction in which shall extend, within the working day, to 280 or 320 hours in each year, at the option of the local authority, and be distributed over such times and seasons as may seem desirable; the regulations in respect of young persons between the ages of sixteen and eighteen are, however, not to apply within seven years of the appointed day. When in full operation these continuation-school courses will deal with some two and a quarter millions of young people who have hitherto entirely failed to continue their education. It is gratifying to note that this feature of the Act is already being brought into effect by many large firms in the North of England. The Act further encourages the co-operation and combination of neighbouring authorities in any schemes, especially those relating to higher education. The crux of the Act lies in a due supply of efficient teachers, but with the offer of better salaries, improved prospects, and adequate pensions this essential may be assured.

THE PUBLIC HEALTH.[1]

THE annual survey of the public health of England and Wales by the Medical Officer of the Local Government Board recently issued contains matter of considerable general interest.

The first few pages of the report are devoted to a useful review of events since 1871, the year in which the Local Government Board was established. The data given show clearly the improvement of the public health since that year. For instance, the total death-rate for 1911–15 is from 42 to 50 per cent. less than that obtaining in 1871–80 for all ages up to forty-five, and at every subsequent age-period a substantial reduction has been secured. The number of lives saved *every year*, due to reduction of the death-rate, between 1871–80 and 1910–12 averaged 234,955, and the average expectation of life has increased by ten years for males and by nearly eleven years for females.

Almost all diseases during this period show a reduced mortality, the exceptions being influenza (which was not prevalent in 1871–80), diphtheria, and cancer. Some of this registered increase in the crude death-rate from cancer arises from the higher average age of the population, for cancer becomes more frequent as age advances. A still larger proportion is due to more accurate certification of cause of death, but it is still an open question whether the whole of the increase in the mortality from cancer can be thus explained. Whether so or not, cancer remains one of the chief causes of death in man.

The death-rate in young children has been markedly reduced, and the prevalence of typhoid or enteric fever has also rapidly declined since 1911. The former fact is the best index of combined social and sanitary progress, the latter of general sanitary progress.

The needs of the future are next briefly considered: they are regarded as coming under three principal headings—(1) research into the causation of disease on a much larger scale than has hitherto been attempted; (2) extension of communal action for the prevention and treatment of disease, and more complete training of the medical profession for this work; and (3) simplification and strengthening of administrative machinery.

An important section on maternity and child welfare follows. Attention is directed to the declining birth-rate; in 1917 it was only half that of 1874. In spite of a considerable saving in child-life, the rate of survivors to age five of the total population is a steadily declining figure—from 27·1 per 1000 in 1874 to 19·6 in 1916. The effect of this will be that "unless economic or other considerations having an opposite influence come into play, the population, apart from immigration, will ere long become stationary, the birth-rate not more than counterbalancing the death-rate." Infant mortality, including still-births, is discussed. The infant mortality in 1917 for the whole of England and Wales was 97 per 1000 births, as compared with 91 in 1916, the lowest recorded rate. Judging by the past, it is considered that we may anticipate a reduction of the national rate of infant mortality to 50 per 1000 births—a rate already attained in some parts of the country and in New Zealand as a whole—but this desirable end can be secured only by improving the welfare of every mother.

Succeeding sections of the report deal with (*a*) the prevention of acute infectious diseases, from which we learn that 178 indigenous cases of malaria occurred in 1917; and (*b*) the prevention of chronic infectious diseases, of which tuberculosis is the most important. The total deaths from pulmonary tuberculosis have increased since 1913, and in 1917 the increase was 6058, or about one-sixth more than in 1913. This increase was greater among females, due probably to their more extensive employment in industrial occupations with conditions of strain and overcrowding.

The work of port sanitary authorities is surveyed. Rat destruction has been carried out at the principal ports in view of the connection of these rodents with plague infection; some 110,000 rats have been destroyed in the ports of London, Liverpool, and Hull, and of some 12,000 rats specially examined five were found to be plague-infected.

Appendices contain the reports of inspectors on outbreaks of infectious disease, statistical tables, etc.

R. T. H.

[1] Forty-seventh Annual Report of the Local Government Board, 1917–18. Supplement containing the Report of the Medical Officer for 1917–18.

AN INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH FOR JAPAN.

THE idea long cherished by some of the scientific men in Japan of establishing a national institute of scientific research has, in part at least, been realised—in part, first, because the Institute of Physical and Chemical Research which came into existence as a legal body in March, 1917, does not, as its name implies, cover the whole field of science; and, secondly, because the fund now being raised in its support is not quite sufficient to place the institute upon such a financial basis as was at first contemplated. Nevertheless, it promises a fair start, and, with wise administration and a judicious choice of the staff, it is hoped that the institute may do some useful work for the progress of science and industry.

The outbreak of the great war in 1914, which at once cut off the import, mainly from Germany, of dyestuffs, drugs, and other products of daily necessity, and at one time almost gave rise to a panic in business, was responsible for producing a profound change in the mental attitude of the Government officials, the business men, and, in fact, the whole nation towards science. Those who had in vain been preaching the supreme importance of cultivating science with all activity and pleading for public support now saw at once that the right opportunity presented itself, and lost no time in drawing up a definite plan for an institute of physical and chemical research—a plan which, though not ideal, was deemed to be practicable and to meet the most urgent need. This, fortunately, obtained the cordial support of some of the most influential and public-spirited of the business men, particularly of Baron Shibusawa, and afterwards also of the Government, of which Count Okuma was at the time Premier.

According to the plan, which was ultimately adopted, a fund of 5,000,000 yen (10 yen = 1*l*.) was to be raised by public subscription. Of this sum just about one-half has already been promised, and is being paid in, almost wholly by those who have either commercial or industrial concerns in Tokyo and Yokohama. The other half is, with good reason, expected to be contributed within a few years by those in Osaka, Kobe, and other large and wealthy cities in the south-western districts. The plan also included an application for a Government subvention, and, in accordance with the Bill passed by the Diet in its 1915–16 session, the Government is giving the institute a subvention of 2,000,000 yen in ten years, whilst H.M. the Emperor has made a gift of 1,000,000 yen for promoting the object of the institute. The total fund, supposing that the public subscription comes up to the expected sum, would thus amount to 8,000,000 yen, of which about 2,500,000 yen has to be invested in land, buildings, and equipment. But since the interest accruing from the fund is calculated to exceed the annual expenditure for the first six or seven, or even more, years, when the activity of the institute cannot of necessity be very great, it is expected that at the end of ten years there will be left over a fund of about 6,000,000 yen, which, calculated at 5 per cent. interest, would yield an annual income of 300,000 yen. To this extent, therefore, the institute would be self-supporting, and it is roughly estimated on this basis that the number of staffs of all grades and of mechanics, laboratory boys, etc., would be between 100 and 120 in all. But it is evident that the institute must grow in both size and activity, and that, therefore, the above income would soon be found to be inadequate to meet the necessary expenses demanded by this growth. As the institute grows in activity, however, its importance will be made more and more evident, and it is believed that there would then be no great difficulty in obtaining more money.

Passing from the financial aspect of the institute to its organisation and work, it may be mentioned that its administration is entrusted to a board of managers, of whom one is a general director and another a vice-director. The scientific work of the institute is carried on in the two departments of physics and chemistry, each of which has a departmental director and a number of staffs, graded as fellows, associate fellows, and assistants. The departmental directors, who are also fellows, superintend the research work in their own departments, but each fellow is expected to undertake researches on his own account, either by himself or in collaboration with other fellows, associate fellows, or assistants. Some of the associate fellows may also carry on independent work. A greater number of the researches would then be of an individual character, but there would also be several cases in which certain problems selected by the institute would be dealt with from all points of view—cases in which a combined effort of a number of fellows and associate fellows, both physicists and chemists, would be required.

It is expected that, in course of time, there would be formed a certain small number of sections in each of the departments of physics and chemistry, with a chief in each section, such, for example, in the chemical department, as the section of inorganic and physical chemistry, and the section of organic and biological chemistry. It is not in contemplation, however, to form separate sections for so-called pure and applied science, still less for such subdivisions as are generally made in applied chemistry, the policy of the institute being to attack industrial problems from a broader and essentially scientific point of view. In this connection it may be mentioned that the institute is expecting a number of special industrial problems to be constantly brought forward for solution by manufacturers, and that the institute would gladly undertake the investigation of such problems, somewhat on the same lines as are followed at the Mellon Institute in Pittsburgh. Such a policy would, it is believed, not only contribute more directly to the development of special industries, but also bring the institute into closer touch with the manufacturing world—a state of things which is evidently essential for bringing about a satisfactory federation of science and industry.

The greatest and most fundamental difficulty experienced in Japan is the lack of really capable researchers, and one of the most important objects of the institute is to train young men in original research. For this purpose a certain number of university graduates are annually elected to research scholarships, which are tenable for two years, preference being always and strictly given to those candidates who have shown signs of originality and development rather than to those who have most distinguished themselves in examinations. During the two years of his term a scholar works at some original research either in the university or in the institute, and if at the expiration of the term he proves himself to be sufficiently satisfactory, and also desirous of getting a situation in the institute, then he will be appointed an assistant. If, however, he prefers to go elsewhere, he is quite free to do so. The institute loses nothing by this, for its object is to train young men in research work, no matter whether they may or may not become members of its staff. An assistant receives further training in the institute by constantly associating himself with the work of one of the senior members of the staff, and is, on being found to be sufficiently capable, promoted to an associate fellowship, and ultimately to a fellowship, with a proportionately increasing salary. A few of the associate fellows are annually sent abroad for further training, there being three (Asahara, Nishi-Kawa, and Takamine) in the United States at present.

The laboratories and workshops of the institute will be built upon a site which has been bought in a northern district of Tokyo, not far from the university, but it will be some years before these are completed. Meanwhile, the research work of the institute is being carried on in the Universities of Tokyo, Kyoto, and Sendai, the authorities of these universities having kindly placed some of their rooms at the disposal of the institute, and the salaries of those engaged in or assisting research for the institute, as well as expenses for instruments, chemicals, etc., being borne by the institute.

It may be added that the reason for making the institute independent in its organisation of either the university or the Government was to enable its staff to devote the whole of its time and energy to research, free from any tutorial work or the drawbacks attending a Government institution.

THE LABORATORY IN THE SERVICE OF THE HOSPITAL.[1]

UNTIL recently the fundamental importance of laboratories as a weapon of offence against disease has received only sporadic recognition, and their pioneer work has not been fostered by any firmly directed policy of encouragement. But the necessity for safeguarding a gigantic army against epidemics—always the supreme menace—has brought into a

[1] Abridged from an address delivered at the opening of the winter session of the Medical School of the Middlesex Hospital on October 1 by Dr. C. H. Browning.

prominent light the indispensable functions of the laboratories, thanks to which, in the brief interval between the South African campaign and the present war, "disease, not battle, digs the soldier's grave" has ceased to be a terrible truth. As regards general recognition, however, the laboratory suffers from the obscurity which surrounds its work. The might-be victim of epidemic disease is unlikely to entertain a lively sense of gratitude on account of his deliverance from the attacks of such minute enemies as the germs of enteric fever or cholera.

Modern Surgery—The Break from the Past.

A superficial observer would discern that in one great particular the hospitals of to-day differ from those of even the near past. I refer to the operations of the surgeon. It was not until towards the middle of last century that the discovery of anæsthetics enabled the surgeon to operate as the nature of the disease demanded, but this liberty of action at first brought small advantage, since wounds became the port of entry for septic infection into the body—a malady often far more deadly than the ailment which it was designed to cure.

Now all this is changed; but no gradual evolution of ideas of common cleanliness, no "broadening down from precedent to precedent," effected this revolution. We owe it to Pasteur, who made the fundamental discovery that putrefaction was due to microscopic living organisms, and to Lister, who secured the triumph of Pasteur's principle in its application to surgery.

Since this work originated from the laboratory, and as its outcome was pre-eminently practical, it is necessary to consider what the terms "science" and "the laboratory" stand for in relation to medicine. In some quarters even yet the suspicion lingers that science and practice are antagonistic, and that biological science will not admit of application to the affairs of everyday life, among which must be reckoned the healing of the sick. Like most other fallacies, this one contains the vestige of a truth, for there are not lacking scientific pedants who disregard what is practical, and who shirk responsibility by eliminating from their interests whatever promises an outcome valuable to mankind. The spirit which animates true science or pure science, as it is often called, is, of course, the search for truth for its own sake, and without, in the first place, entertaining any notion of practical application. It has seldom happened, however, that a new truth remained long without being harnessed to some cart of progress.

Enterprise and Applied Science in Medicine.

While the heaven-sent gift which leads to the discovery of great new truths is bestowed upon only a few individuals of every generation, there is, short of genius, a most precious faculty which is much less rare, and which perfects itself through opportunity and encouragement, the spirit of enterprise, which works out improvements and elaborates new practical applications. It is given to genius to open a door in the blank wall of ignorance by which current knowledge is confined; then enterprise has the courage to pass through that door and laboriously to tread out fresh paths of progress, in spite of prejudice that stands by and sneers. Commercial gain is the usual incentive to enterprise, and the multitude of material conveniences which to the casual eye constitute the distinguishing feature of our modern civilisation testify to the results. But the prospect of commercial advantage is by no means the sole spur which stimulates enterprise, as the long line of Arctic explorations abundantly proves. It is remarkable, however, how little of such enterprise devoted to the advance of medicine there has been until recently, and that far less attention has been paid to the preservation of health than can be commanded by such problems as the production of a dye, the design of an aeroplane engine, or the quest for the North Pole. The explanation of this extraordinary neglect appears to lie in the fact that all enterprise demands for its pursuit the outlay of capital, and that human nature craves an obvious return for its expenditure, whether it be in the form of dividends from a company exploiting some industrial invention or the thrilling story of an explorer's hairbreadth escapes. The laboratory worker, perhaps fortunately for his honesty, is a novice in the art of publicity, and his thrilling story is seldom told; also the results of his achievements are preventive, and so destroy or forestall the very evidence which would continue to proclaim the necessity for their intervention.

When we consider what is the actual sphere of science and the laboratory in medicine, we find that the laboratory worker may be more or less excluded from the cognisance of the symptoms and treatment of the diseased individuals owing to a preconceived notion of his functions on the part of those who control him; whereas the association should be most intimate. Where disease is under consideration, science lies both in method and in experiment. Accordingly, everything that conduces to precision in the investigation and treatment of disease is scientific. The scientific memory substitutes the card-index for the tablet of the mind and replaces impressions by statistical surveys, for the value of an argument depends on the validity of premises. We should probably object to receiving a pound of sugar measured "by the eye" of the vendor, yet until recently the world was content to accept decisions as to the health of its body based mainly on impalpable impressions. Experiment, in addition, is the essential weapon; for Nature, when left to herself, usually presents her problems in so great a tangle that a solution is impossible until she is, so to speak, bridled by the experimenter, who then observes the paths she traverses. It is but natural that such activities should be centralised in a particular department, and that certain workers should by inclination and training devote themselves specially to such tasks; but whoever has made the serious attempt to coax a secret from Nature obtains an outlook the value of which he cannot realise until he enjoys it. So it is an ideal—by no means unrealisable—that every student should be a participator, even though to a small degree, in the joys of discovery, and should receive such practical insight into the methods and the results of scientific inquiry as will enable him later on to weigh evidence and to understand soundness of proof.

Past Achievements of the Laboratories.

The recognition of the causes of bacterial diseases marked the first step of progress. The methods necessary for the prevention of infective diseases then often followed as a corollary. Thus the practical abolition of typhoid fever in the Army by means of preventive inoculation and the detection of carriers, also the prevention of tetanus by the administration of anti-tetanic serum to the wounded, are achievements the magnitude of which it is not possible to exaggerate. It is a literal fact that if any of the combatant countries neglected to act upon the established teachings of bacteriology, defeat would overtake it on that account alone. The calamities which ensue when the disorganisation due to war destroys arrangements essential for the preservation of hoarded masses of human beings have been terribly illustrated in Serbia and Rumania. The plague of lice, which infested and throve among those unfortunates, harboured the more terrible plagues of typhus and relapsing fever. Although scientific investigation had shown conclusively that destruction of lice enabled typhus fever to be extinguished, and that relapsing fever could be cured by salvarsan, neither of these facts could be acted on. "And now arose a situation that can only be compared to the description in Defoe's 'Journal of the Plague Year.'"[2] This brief sentence sums up the agony of a nation.

Another domain in which the laboratory with its experimental methods is indispensable is the study of the action of drugs, together with the elaboration of new therapeutic substances. Thus adrenalin, which is of such great service in performing bloodless operations, is a drug manufactured in the living body itself, but the synthetic chemist has built it up in the laboratory. Salvarsan was invented as the result of years of investigation, in which both the biologist and the chemist played essential parts. This drug, which has placed in the hands of the therapist a weapon of previously undreamt-of potency in the treatment of one of the gravest and most prevalent infective diseases, syphilis, represented the zenith of the life-work of a man of genius, but it is certain that without the gigantic force of Germany's chemical industry Ehrlich's scientific triumph could not have had its practical accomplishment. The search for drugs which shall exert specific actions in the living body affords a most promising field of investigation, and offers rich results in the amelioration of suffering. Much attention has been devoted to this subject at the Bland-Sutton Institute, and in the flavine compounds, belonging to the group of acridine dyes, substances have been found which possess unique properties as antiseptics, and have been utilised with great advantage by surgeons in their efforts to combat and to prevent the serious consequences of septic infection in war wounds.[3]

Future Work of the Laboratories.

Such enterprise, however, is still in its infancy. There is a great prospect here for the co-operation of chemists and biologists, for it is only by such team-work that the complexity of modern problems can be resolved. The investigation of many diseases has now reached a stage at which it is futile merely to ask what are the gross marks which they leave behind when they have wrecked health or destroyed life, or what are the agencies which cause these ravages and how we can prevent their attacks. Now we must proceed further and inquire what are the first evidences of the operations of these enemies and by what means can an actual cure be effected. The diseases in which this most important step can be taken are as yet all too few. It must be remembered, however, that prevention is not always possible; therefore, one must still strive after cure. This subject demands serious attention; it is a general belief that sanatoria and the propaganda of education directed towards the prevention of tuberculosis will eradicate this dire disease. But even if tuberculosis may some day become extinct, it is certain that for at least several generations to come cure will continue to be a clamant need, which still we have nothing definite to satisfy.

The Organisation of the Work of the Laboratories.

The information yielded by the laboratory supplies in a great and ever-increasing proportion of cases the indications which are essential for the proper diagnosis of the disease and treatment of the patient; but much of this work has now become routine, and it is most unfortunate that it has frequently been entitled "clinical research." The name is totally misleading, and no policy more inimical to progress could be conceived than that of many hospitals which make arrangements solely for this class of hackwork. It is essential that such investigations should occupy only a portion of the time of the laboratory's staff, and that portion by no means the major one. The chronic and hopeless diseases which occupy so great a part of the medical wards of a hospital, and of which the beginning is obscure, the progress relentless, and the end desperate; epidemic diseases, which yearly cost the City of London alone about half a million pounds; tuberculosis, which probably extorts a greater toll of active adult lives than any other single disease—all these proclaim the necessity for the laboratory workers and the clinicians to co-operate in attacks on disease, not merely from the point of view of the individual patient, but also on a collective basis and with the view of perfecting further methods of prevention and of cure.

It was stated lately in the daily Press that in Australia the blow-fly had caused in one season a loss of sheep to the value of 300,000*l.*, and that, in an endeavour by scientific methods to put an end to this and similar losses, an outlay of 5000*l.* had been decided on. How much more urgently does the whole subject of human disease demand investigation on a scale never hitherto contemplated! In the past this might have been deemed a luxury, in the future it will be recognised as a bare necessity, and of the belligerent countries that which most rapidly builds up its national health will have gone far towards reaping the fruits of victory. By what administrative methods this can be accomplished is a question not discussed here; but one point is clear: that the problems of disease must be solved by the hospitals with the aid of their laboratories, where alone is to be found the stimulus afforded by the problems always present in insistent form. But the problems must be grappled with on a far broader basis than has hitherto been attempted. Medical science is essentially applied science, and the institutes of medical science, if they are to be efficient, must not merely retain the services of all departments of biological science, including biological chemistry, but also include synthetic chemists and physicists. The importance of such a plan has been most fully recognised in America, and has its completest material embodiment in the Rockefeller Institute for Medical Research with the hospital attached thereto, the yearly income of which, derived from endowment, amounted to 600,000*l.* in 1917.

It is specially desirable, too, that the facilities available in the research laboratories of the great manufacturing concerns should be co-ordinated in this scheme. Short of the most thorough comprehensiveness, research in practical medicine is likely to fail to tackle the problems which are of paramount importance.

Prospective Results.

But any scheme of this kind which depends for its continuance on payment by results is foredoomed to failure. This principle has been accepted even for the industrial laboratories; how much more readily ought it, then, to be recognised where the elusive phenomena of life are under investigation, and where the gains take the form of preservation of health and diminution of the burden of human suffering! Health is one of the greatest assets of a people, and this work, which will enhance the value of that asset to an almost incalculable degree, is of the highest national necessity.

[2] Majors H. G. Wells and R. G. Perkins, members of the American Red Cross Commission to Rumania.

[3] It was owing to the action of the Medical Research Committee that the flavine compounds were rendered available.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Misses Bunce have made a further very handsome donation of books to the University library, a gift which is of special interest from its association with the late J. Thackray Bunce, who gave valuable services to the University in its earlier stages.

Prof. Percy F. Frankland is resigning the Mason chair of chemistry at the end of the current term. In accepting the resignation with great regret, the Council has expressed to Prof. Frankland its thanks for valuable services rendered to the University during the past twenty-four years, and its hope that the leisure which will follow his resignation will result in his complete restoration to health.

Dr. Parker has resigned his appointment as assistant lecturer and demonstrator in chemistry on being elected research chemist to the Joint Committee of Leeds University and the Institution of Gas Engineers.

IN a letter to Sir John Williams, president of the University College of Wales, Aberystwyth, Major David Davies offers, with his sisters, to contribute the sum of 20,000*l.* to found a chair of international politics at Aberystwyth, in memory of the fallen students of the University of Wales, "for the study of those related problems of law and politics, of ethics and economics, which are raised by the project of a League of Nations, and for the encouragement of a truer understanding of civilisations other than our own." If the proposal is accepted, the donors hope that the chair will be associated with the name of President Wilson.

IN connection with the recent deputation to Mr. Fisher and Mr. Bonar Law to ask for augmented State grants for university purposes, the question of increased remuneration for the non-professorial staff is attracting considerable attention. It is urged that immediate steps should be taken to remedy the present conditions, which should be made widely known. The average annual salary of 330 lecturers in fifteen universities and university colleges of England, Wales, and Ireland is 206*l.* Only 37 per cent. of the lecturers receive a salary above 200*l.* a year, and it is only in the case of these lecturers that the contributory scheme, known as the Federated Superannuation Scheme, is applicable. University teachers are excluded from the operation of the Superannuation Bill for Teachers in Secondary Schools and Technical Colleges, recently passed into law. Conferences of lecturers in universities and university colleges have formulated a scheme for a new salary scale, which has been submitted to the governing bodies and to H.M. Government. At the last conference, which was held at King's College, London, on November 30, it was decided to press for the inclusion of university teachers in a non-contributory pension scheme. It may be pointed out that in the case of the scientific staff, already depleted through the ravages of the war, these matters are of urgent importance in view of the further diminution that may occur through the increased demand for scientific experts in the Government services and in industry.

A REPORT on the work done in London educational institutions during the past three and a half years in the manufacture of munitions and training of munition workers was before the Education Committee of the London County Council on December 12. It appears from a statement by the Education Committee that in June, 1915, the Council agreed to place its resources at the disposal of the Ministry of Munitions and the Metropolitan Munitions Committee. Two lines of action were adopted:—(1) The manufacture of such essential munitions as could be made with the staff and machines available in technical institutions, and (2) the training of workers for munition factories. In connection with the manufacture of munitions the main efforts of the organisation have been directed to the manufacture of precision gauges. About 83,000 gauges have been delivered and passed by the National Physical Laboratory; in addition, sixty-five orders for miscellaneous types of accessories have been completed. With regard to the second item, more than 12,000 students have been in training, of whom about 9000 have completed their courses satisfactorily and been placed in employment. The staff engaged on this work at December 1 last numbered in all 482 persons, 44 of whom belonged to technical institutions, 193 had been transferred from their normal posts in various kinds of schools, and 245 were temporary employees. Machinery and equipment to the amount of about 17,000*l.* have been purchased for manufacture and remain the property of the Council. Certain funds will be available for the reconstitution and equipment of workshops in technical institutions from the manufacturing side. The total value of the work carried out for the manufacture of munitions and the training of munition workers has been of the order of 300,000*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 21.—Sir J. J. Thomson, president, in the chair.—W. **Stiles** and Dr. F. **Kidd**: The influence of external concentration on the position of the equilibrium attained in the intake of salts by plant-cells. The course of intake of salts by carrot and potato tissue has been followed by measuring the changes in electrical conductivity of the solution of salt presented to the tissue. Concentrations of each salt were employed, ranging from 0·1 to 0·0002 normal. In the case of copper sulphate exosmosis from the tissue exceeds absorption, and this is so with all concentrations of the salt. This is characteristic of toxic substances. Carrot tissue absorbs the chlorides of potassium, sodium, and calcium in all concentrations employed. Absorption takes place at first at a rate approximately proportional to the external concentration, but this relation is not continued with time, as the absorption progresses towards an equilibrium condition in which the ratio of internal to external concentration is not constant, but varies with the concentration. This ratio of internal to external concentration we call the absorption ratio. It decreases with increasing concentration. With low external concentrations, *e.g.* 0·0002*N* and 0·002*N*, it is many times unity; with higher concentrations, *e.g.* 0·1*N*, it is less than unity. The data presented are regarded as inadequate in themselves to justify the conclusion that absorption of salts by the cell is an adsorption process.—W. **Stiles** and Dr. F. **Kidd**: The comparative rate of absorption of various salts by plant tissue. The absorption of various chlorides, sulphates, nitrates, and potassium salts from solutions of 0·02*N* concentration was measured by the electrical conductivity method employed in the investigation recorded in the previous paper. Kations appear to be absorbed initially in the following order:—K[Ca,Na]Li[Mg,Zn]Al. The position of ions enclosed within brackets may have to be reversed. This initial order does not indicate, however, the extent to which the ions are absorbed when equilibrium is reached; the order is then K,Na,Li[Ca,Mg]. The chief difference between this order and the initial order is in the position of Ca, which is ultimately absorbed to only a slight extent compared with K and Na. Anions are absorbed initially in the order SO_4,NO_3,Cl, which gives place later to the order NO_3,Cl,SO_4 on account of the comparatively slight extent to which the sulphate ion is absorbed. The difference between nitrate and chloride is slight, and no stress can be laid on it. These results agree in general with those of Ruhland, Fitting, Pantanelli, and Troendle using different methods and different experimental material. These authors did not, however, distinguish between initial rates of absorption and the position of final equilibrium. The position of final equilibrium appears to be governed by some quite different property from that which determines the initial rate of intake.—G. **Marinesco**: Recherches anatomo-cliniques sur les névromes d'amputations douloureux. Nouvelles contributions à l'étude de la régénération nerveuse et du neurotropisme.

Physical Society, November 8.—Prof. C. H. Lees, president, in the chair.—Prof. J. C. **McLennan**: Low-voltage arcs in metallic vapours. The paper describes experiments by Messrs. Hamer and Kemp, students of the author's, at Toronto University. The experiments show that increasing the temperature of the incandescent cathode lowers the voltage necessary to produce arcs in the vapours of mercury, zinc, and cadmium. With limed platinum cathodes arcing voltages were not obtained so low as with incandescent tungsten filaments. With mercury it was found possible to strike arcs with voltages as low as 4·75 volts, and to maintain them at 2·84 volts. Corresponding figures for cadmium were 5 and 2 volts. To obtain these very low arcing voltages it was necessary to use intensely hot cathodes and a copious supply of highly heated metallic vapour. With moderately heated incandescent cathodes and a moderate supply of metallic vapour the arcing voltages were given by the quantum relation $V = h \times (1{\cdot}5, S)/e$, where 1·5,S is the frequency of the shortest wavelength in the $\nu = 1{\cdot}5, S - mP$ series.—Dr. W. **Wilson**: Relativity and gravitation. The motion of a particle in a gravitational field is treated from the point of view of the general theory of relativity. It is shown that the equations of motion of the particle can be expressed in the following Hamiltonian form:—

$$\frac{dp_s}{d\tau} = -\frac{\partial H}{\partial x_s},$$
$$\frac{dx_s}{d\tau} = \frac{\partial H}{\partial p_s},$$

where p_s is the s component of the covariant 4-vector momentum, x_s the corresponding positional co-ordinate, and τ the Minkowskian "Eigenzeit." A short outline of the Minkowskian theory of relativity is included in the paper.—C. R. **Gibson**: Experiments on colour-blindness. The apparatus shown consisted of a lantern to produce a bright beam of white light and a coloured glass which could be slipped in front of it, so as to cut out all the red rays. Various samples of coloured cloths and ribbons arranged in pairs, while quite dissimilar when viewed by the white light, appeared perfect matches with the screen interposed, the conditions then being similar to those in the case of a red-blind person. The author had found in experimenting with wools by this method that many coloured wools were unsuitable for the purpose on account of fluorescence. Thus although no red light fell on them from the apparatus, there was plenty of red in the light reflected by the wools. In these cases, in order to see what the colours would appear to the red-blind man, it was necessary to have the filter between the wool and the eye, and not simply between the source of light and the wool.

Royal Anthropological Institute, November 26.—Prof. A. Keith, past president, in the chair.—Prof. F. G. **Parsons**: Some points in the anthropology of German prisoners of war. Owing to the refusal of the German military authorities to allow the Army to be used for anthropometric purposes, the anthropology of Germany was probably less well worked out than that of any other European country. The author's present contribution consisted of observations on 925 German prisoners in the war hospitals at Sutton and Dartford, and included the cephalic index, the facial index, the index of nigrescence, and the stature, though his generalisations on the last point were still incomplete, as there existed a large mass of statistics in the hands of the Government to be worked up. With regard to the cephalic index, he found that the German average was 82·5, against the 78·2 of 227 British soldiers and medical students, and that the German head was not only actually shorter, but also actually broader than the British. A map of the distribution of the head-form in Germany showed that the longest heads were found in the north-west (Schleswig, Hanover, Westphalia, and Rhineland), while the shortest were in the south-east (Bavaria and Silesia). The lowest cephalic index was that of Oldenburg (802), and the highest Bavaria (845). The facial index showed no approach to the long Nordic face of England and Scandinavia anywhere in Germany, while a map of the index of nigrescence showed that the colouring of the people had a general agreement with the head shape, the lighter pigmentation accompanying the longer heads, and *vice versa*.

PARIS.

Academy of Sciences, November 18.—M. P. Painlevé in the chair.—M. J. A. Battandier was elected a correspondant for the section of botany in succession to the late M. Grand'Eury.—J. **Droch**: The complex groups of rationality and the integration by quadrature.—T. **Lalesco**: Periodic polygonal functions.—R. **Garnier**: Elementary solution of the problem of the inversion of elliptic functions.—R. **Goormaghtigh**: Generalisation of Jamet's theorems on the curvature of triangular curves, and of symmetrical tetrahedral curves and surfaces.—E. **Belot**: The laws of internal density in theories of the sun.—E. **Hildt**: The estimation of lactose. The use of benzene or phenolsulphonic acid is recommended for the hydrolysis.—J. **Lambert**: The presence of a fasciole in a Procassidulid.—P. **Bertrand**: Distinctive characters of the flora of the Coal Measures of Saint-Etienne and Rive-de-Gier.—A. **Piédallu**: A new arrangement for the use of explosives applied to tree planting. Its advantageous utilisation in the rapid reconstitution of orchards devastated by the enemy. The use of a special cartridge is suggested for making holes suitable for tree planting.—A. **Grigaut** and Fr. **Moutier**: An attempt at the treatment of influenza by plasmotherapy (intravenous injections of plasma from a convalescent). The treatment is effective only if the injection is made before the third day of the attack.—C. **Richet**: Comments on the preceding paper.

November 25.—M. P. Painlevé in the chair.—Gen. **Bourgeois**: A method of determining the direction and velocity of the wind in cloudy weather. Small balloons are let up, arranged so as to explode small charges of melenite at regular intervals; sound telemeters record the explosions, and the position in space of the points of detonation can be thus determined.—M. Maurice Leblanc was elected a member of the division of science applied to industry, and M. Sauvageau a correspondant for the section of botany in succession to the late Charles Eugène Bertrand.—M. **Petrovitch**: The spectral determination of functions.—P. **Humbert**: The Poincaré surfaces of order 6.—J. de **Schokalsky**: The hydrographical exploration of the coasts of Siberia in 1918 by the Russian Marine Ministry.—J. **Mueller**: The solubility of copper hydroxide in presence of sodium and potassium hydroxides. Concentrated solutions of caustic potash and soda keep in solution appreciable quantities of copper hydroxide. On diluting and boiling, in some cases all the copper is still held in solution; in others some of the copper is precipitated. No organic substance or other metallic oxide was present in these experiments.—T. **Komninos**: A new synthesis of aromatic from fatty compounds. Acetone and malonyl chloride react in presence of marble, and from the products of the reaction the substance

$$CH_3—CO—CH_2—CO—CH_2—COCl$$

was isolated. This loses another molecule of hydrogen chloride under the action of marble, giving phloroglucinol. This synthesis can probably be generalised.—J. de **Lapparent**: The felspar crystals developed in limestones of the Upper Pyrenees Cretacean.—M. **Molliard**: The production of glycocoll by *Isaria densa*. The growth of this fungus on gelatine gives a yield of 33 per cent. of this amino-acid, whilst the acid hydrolysis of gelatine gives only half this amount. Fibrin, hydrolysed by acids, gives only 3 per cent. of aminoacetic acid, whilst the fungus gives a 38 per cent. yield.—J. **Amar**: The mental function in feminine work.—P. **Godin**: Practical application of the "Fiche scolaire" (mental and physical record) to a pupil followed from 11 to 12½ years of age.—J. **Nageotte** and L. **Sencert**: Functional grafts of dead arteries.

BOOKS RECEIVED.

Archæological Survey of India. New Imperial Series. Vol. xl. The Astronomical Observatories of Jai Singh. By G. R. Kaye. Pp. viii+151+xxvi plates. (Calcutta.) 23*s*.

Submarine and Anti-Submarine. By Sir H. Newbolt. Pp. viii+312. (London: Longmans and Co.) 7*s*. 6*d*. net.

Cotton. By G. Bigwood. Pp. viii+204. ("Staple Trades and Industries.") (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

The Psychology of Conviction: A Study of Beliefs and Attitudes. By Prof. J. Jastrow. Pp. xix+387. (Boston and New York: Houghton Mifflin Co.; London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 12.

ROYAL SOCIETY, at 4.30.—Leonard Hill and Hargood Ash: The Cooling and Evaporative Powers of the Atmosphere, as Determined by the Katathermometer.—H. C. Bazett: Observations on Changes in the Blood Pressure and Blood Volume following Operations in Man.—Dr. M. C. Stopes: The Four Visible Ingredients in Banded Bituminous Coal.

OPTICAL SOCIETY, at 8.—Instructor-Commander T. Y. Baker and Major L. N. G. Filon: An Empirical Formula for the Longitudinal Spherical Aberrations in a Thick Lens.—Major E. O. Henrici: Spirit Levels.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on Electric Welding.

MATHEMATICAL SOCIETY, at 5.—G. H. Hardy and J. E. Littlewood: Applications of the Method of Farey Dissection in the Analytic Theory of Numbers: (1) A New Solution of Waring's Problem; (2) Proof that every Large Number is the Sum of at most 33 Biquadrates; (3) The Riemann Hypothesis and the Expression of a Number as the Sum of a Stated Number of Primes.—N. M. Shah and B. M. Wilson: Numerical Data connected with Goldbach's Theorem.

FRIDAY, DECEMBER 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. Lunt: The Dark Line Spectrum of Nova Geminorum No. 2.—A. King: A Shower of Shooting Stars from the Pleiades.—J. H. Jeans: The Evolution of Binary Ssytems.—C. P. Butler: The Presence of G and K Type Bands in the Early Spectra of Nova Aquilæ III (1918).—*Probable Paper*: A. A. Rambaut: Observations of the Magnitude of Nova Aquilæ, 1918, made at Radcliffe Observatory, Oxford, and a Comparison with the Radcliffe Magnitudes of Nova Persei, 1901.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

MONDAY, DECEMBER 16.

ROYAL GEOGRAPHICAL SOCIETY, at 5.

ROYAL SOCIETY OF ARTS, at 5.—Prof. J. C. Philip: Physical Chemistry and its Bearing on the Chemical and Allied Industries.

ARISTOTELIAN SOCIETY, at 8.—Prof. John Laird: Synthesis and Discovery.

TUESDAY, DECEMBER 17.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Papers to be Discussed*: E. L. Leeming: Road-corrugation.—F. Wood: Investigations in the Structure of Road-surfaces.—T. B. Bower: Notes on Road Construction and Maintenance.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—Dr. F. Mollwo Perkin: The Production of Oil from Mineral Sources.

ROYAL STATISTICAL SOCIETY, at 5.15.—Dr. John Brownlee: Notes on the Biology of a Life Table.

WEDNESDAY, DECEMBER 18.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Col. A. Castellani: Tropical Diseases met with in the Balkanic War Zone.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Capt. C. J. P. Cave, R.E.: A Cloud Phenomenon.—C. E. P. Brooks: Notes on a Meteorological Journal at Wei-Hai-Wei, kept by Commander A. E. House, R.N., 1910–1916.—Capt. E. H. Chapman: The Annual Symmetrical Variation of Certain Elements and a Note on the Choice of Seasons.

THURSDAY, DECEMBER 19.

CHEMICAL SOCIETY, at 8.—Prof. F. Soddy: The Conception of the Chemical Element as Enlarged by the Study of Radio-active Change.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—P. Hunter-Brown: Carbon Brushes, Considered in Relation to the Design and Operation of Electrical Machinery.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion opened by the President*: Summary of Progress in Photometry, with Special Reference to War Problems.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

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Registered as a Newspaper at the General Post Office.]

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

FACULTY OF ENGINEERING.

Arrangements have now been completed :—

(1) To enable students, whose courses have been interrupted by war service, to resume them as nearly as possible at the point at which they left off, by rejoining at the beginning of the second term, *January* 13, 1919.

(2) To enable students, who were unable to begin their Engineering Studies last October owing to war conditions, to begin them by entering next term, *January* 13, 1919.

For both classes of students additional work will be provided during parts of the Easter and Long Vacations, so as to enable them to get in a full Session's work between January and August, 1919.

OTHER FACULTIES.

Arrangements of a like kind are in contemplation in the other Faculties, and will be made if a sufficient number of entries are received on or before January 6, 1919.

Students in either of these categories in any Faculty should apply at once to the PROVOST, University College, London (Gower Street, W.C. 1).

UNIVERSITY OF BRISTOL. DEMOBILISATION.

SPECIAL REGULATIONS have been made to allow intending students who have served in the war or in the scientific service of the war to be admitted to matriculation by vote of Senate on their educational qualifications, without formal examination ; and also to allow of such students entering the University in January if candidates in Arts ; in January, or between January and May, if candidates in Science, Medicine, Dental Surgery, or Engineering ; and if grounds be shown, counting their first year's attendance as though it had commenced in October. Engineering students in special cases may be allowed to count one whole year's attendance.

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E. SALTER DAVIES,
Director of Education.

December, 1918.

ROYAL INSTITUTION OF GREAT BRITAIN,

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LECTURE ARRANGEMENTS BEFORE EASTER, 1919.

CHRISTMAS COURSE (adapted to a Juvenile Auditory). (Illustrated.)

Professor D'ARCY W. THOMPSON, C.B., F.R.S.—Course of Six Lectures on "THE FISH OF THE SEA." (1) "JELLY-FISHES," (2) "STAR-FISHES," (3) "CRAY-FISHES," (4) "CUTTLE-FISHES," (5) "THE HERRING FISHERY," (6) "THE WHALE FISHERY." On Dec. 31 (Tuesday), Jan. 2, 1919 (Thursday), Jan. 4 (Saturday), Jan. 7 (Tuesday), Jan. 9 (Thursday), Jan. 11 (Saturday), at Three o'clock.

TUESDAYS.

Professor SPENSER WILKINSON.—Three Lectures on "LESSONS OF THE GREAT WAR." On Tuesdays, Jan. 14, 21, 28, at Three o'clock.

Professor J. T. MACGREGOR-MORRIS, M.I.E.E.—Two Lectures on "THE STUDY OF ELECTRIC ARCS AND THEIR APPLICATIONS." On Tuesdays, Feb. 4, 11, at Three o'clock.

Captain G. P. THOMSON.—Two Lectures on (1) "THE DEVELOPMENT OF AEROPLANES IN THE GREAT WAR," (2) "THE DYNAMICS OF FLYING." On Tuesdays, Feb. 18, 25, at Three o'clock.

Professor HELE-SHAW, F.R.S.—Two Lectures on "CLUTCHES." On Tuesdays, March 4, 11, at Three o'clock.

Professor ARTHUR KEITH, M.D., F.R.S., Fullerian Professor of Physiology.—Four Lectures on "BRITISH ETHNOLOGY, THE PEOPLE OF SCOTLAND." On Tuesdays, March 18, 25, April 1, 8, at Three o'clock.

THURSDAYS.

Professor J. NORMAN COLLIE, F.R.S.—Three Lectures on "CHEMICAL STUDIES OF ORIENTAL PORCELAIN." On Thursdays, Jan. 16, 23, 30, at Three o'clock.

WILLIAM WILSON, M.B., F.R.A.S.—Two Lectures on "THE MOVEMENTS OF THE SUN, EARTH, AND MOON" (illustrated by a new Astronomical Model), on Thursdays, Feb. 6, 13, at Three o'clock.

Professor H. MAXWELL LEFROY.—Two Lectures on (1) "INSECT ENEMIES OF OUR FOOD SUPPLY," (2) "HOW SILK IS GROWN AND MADE." On Thursdays, Feb. 20, 27, at Three o'clock.

CHARLES AITKEN, Director of the National Gallery of British Art.—Two Lectures on (1) "ROSSETTI," (2) "WHISTLER AND SARGENT." On Thursdays, March 6, 13, at Three o'clock.

Professor CHARLES H. LEES, F.R.S.—Two Lectures on "FIRE CRACKS AND THE FORCES PRODUCING THEM." On Thursdays, March 20, 27, at Three o'clock.

Professor ALEXANDER FINDLAY, D.Sc.—Two Lectures on "COLLOIDAL MATTER AND ITS PROPERTIES." On Thursdays, April 3, 10, at Three o'clock.

SATURDAYS.

Rev. Canon J. O. HANNAY.—Two Lectures on "THE IRISH LITERARY RENAISSANCE." On Saturdays, Jan. 18, 25, at Three o'clock.

Professor HUGH PERCY ALLEN, Director of the Royal Academy of Music.—Three Lectures on "THE WORKS OF J. S. BACH" (with musical illustrations by members of the Bach Choir). On Saturdays, Feb. 1, 8, 15, at Three o'clock.

The Hon. JOHN WILLIAM FORTESCUE, C.V.O.—Two Lectures on "THE EMPIRE'S SHARE IN ENGLAND'S WARS." On Saturdays, Feb. 22, March 1, at Three o'clock.

Professor Sir J. J. THOMSON, O.M., Pres. R.S., Master of Trinity, Professor of Natural Philosophy, Royal Institution.—Six Lectures on "SPECTRUM ANALYSIS AND ITS APPLICATION TO ATOMIC STRUCTURE." On Saturdays, March 8, 15, 22, 29, April 5, 12, at Three o'clock.

Subscription (to Non-Members) to all Courses of Lectures, Two Guineas. Subscription to a Single Course of Lectures, One Guinea, or Half-a-Guinea. Tickets issued daily at the Institution, or sent by post on receipt of Cheque or Post-Office Order.

The FRIDAY EVENING MEETINGS will begin on January 17, at 5.30 p.m., when Professor Sir JAMES DEWAR will give a Discourse on "LIQUID AIR AND THE WAR." Succeeding Discourses will probably be given by Lieut.-Col. ANDREW BALFOUR, Professor H. H. TURNER, Professor J. G. ADAMI, Professor CARGILL G. KNOTT, Mr. A. T. HARE, Professor J. A. MCCLELLAND, Professor H. C. H. CARPENTER, Professor ARTHUR KEITH, Professor W. W. WATTS, The Rt. Hon. Sir JOHN H. A. MACDONALD, Professor Sir J. J. THOMSON, and other Gentlemen. To these Meetings Members and their Friends only are admitted.

Members are entitled to attend all Lectures delivered in the Institution, the Libraries, and the Friday Evening Meetings, and their families are admitted to the Lectures at a reduced charge. Payment : first year Ten Guineas, afterwards Five Guineas a year ; or a composition of Sixty Guineas.

Persons desirous of becoming Members are requested to apply to the SECRETARY.

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THURSDAY, DECEMBER 19, 1918.

CHEMICAL INDUSTRY, NOW AND HEREAFTER.

Reports of the Progress of Applied Chemistry. Vol. ii., 1917. Pp. 536. (London: The Society of Chemical Industry, n.d.) Price 6*s.* 6*d.*

THE annual reports of the Society of Chemical Industry on the progress of applied chemistry ought to be, and no doubt are, much appreciated by all who are concerned in the development and extension of applied science. Next to the institution of their journal, no action of the society will more directly conduce to the interests of that branch of human activity which it is their special function to advance. These reports seek to bring to a focus, as it were, year after year, all additions to knowledge and to practice in the various departments of applied chemistry, as grouped in the fortnightly issues of the journal of the society. This journal was originally made up of (1) original contributions to the different local sections; (2) abstracts of papers bearing upon technical chemistry published elsewhere; (3) abstracts of chemical patent literature; and (4) reports of the annual meetings of the society, with occasional editorial reviews and notices on subjects of general interest to industrial chemists. During the present year this last item has been considerably enlarged, and placed under special direction. It is an extension, in fact, of the society's activities, and the element of "news" thereby imparted to the journal will presumably increase the number of its regular readers and add to its popularity. It is, however, mainly upon the sections of the journal as hitherto constituted that these annual reports will continue to be based. The journal itself is so admirably indexed that at first sight it might seem that these *aperçus* are in great measure superfluous. If they were simply amplified indexes—mere *catalogues raisonnés*—their value would be very limited. But the fact that each section has been entrusted to men of knowledge and discrimination, identified with and professionally interested in the subject with which they are concerned, puts a particular value on the whole work and stamps it with a special utility.

The present issue, dealing with the work of 1917, is the second volume in the series. The first volume suffered to some extent from the fact that it was the initial number. It was a new venture, and experience was needed in order to secure a reasonably high standard, comprehensiveness, and uniformity of treatment. A comparison of this volume with its predecessor shows that this to a large extent has been gained, and that the general lines of the work have now been satisfactorily settled. The new volume has been enlarged by the inclusion of several subjects which were not specially dealt with in vol. i., viz. "Plant and Machinery"; "Fibres, Textiles, Cellulose, and Paper"; "Bleaching"; "Dyeing"; "Printing and Finishing"; "Metallurgy of Iron and Steel"; "Metallurgy of the Non-ferrous Metals"; "Sugars, Starches, and Gums"; and "Electrochemistry." This to a large extent, although not wholly, accounts for the increased size of vol. ii. Some of the reports—*e.g.* that by Prof. Morgan on "Colouring Matters and Dyes," and that by Mr. Ling on "Fermentation Industries"—have been considerably enlarged. But in the main the space needed for the treatment of the several sections is substantially the same in the two volumes, which seems to indicate that, in spite of the prolongation of the war, the activity of chemical industry as a whole, as indicated by additions to the literature of chemical technology, suffered no marked diminution, although particular departments were no doubt affected.

A valuable feature of these reports, which might have been more uniformly adopted, is the short, comprehensive introduction to their particular section in which certain authors review the more striking indications of change or progress during the twelve months which have elapsed since the previous reports were published. It is here that the knowledge, judgment, and critical skill of the reporter are needed, and it is the judicious exercise of these attributes that serves to differentiate him from the mere compiler. Your wisest clerk, as Queen Elizabeth, quoting Chaucer, once said, is not always your wisest man. It requires a certain *flair*, not always possessed by the bookish man, however wide his reading, to discern the true inwardness and trend of a movement, and it is not to be expected that all who contribute to this work should possess this faculty in equal degree. No doubt certain branches of chemical industry move slowly, and years are needed to perceive that any substantial change has overtaken them. Nevertheless, each branch affects, to a greater or less degree, every other, and processes, methods, and machinery and modes of management are transferred from one to the other. It is thus that the Society of Chemical Industry, through its journal and its annual reports, influences the progress of the chemical arts as a whole, and it is for this reason that we shall continue to welcome each successive sign of its publishing activities.

As was to be expected, the general character of the reports is affected, to a greater or less extent, by the war, and most of the contributors have something to say as to its influence upon the industries with which they are concerned. Although, of course, there are exceptions, it cannot be said that the war, on the whole, has adversely affected the future of chemical industry in this country. On the contrary, under the stress of necessity, it has given an impetus in certain directions that will be maintained. New industries have been started, and old ones invigorated and extended, and it can scarcely be doubted that with the establishment of peace and the resumption of undisturbed oversea communications a new era of prosperity will dawn upon chemical industry. It is perfectly obvious that Germany has experienced a great set-back, and it may be doubted whether she will ever again attain the ascendancy in certain departments which she has now sacrificed by her unscrupulous greed, bad faith, and insatiable rapacity. It now rests with the manufacturers and workers in this country to determine how far they mean to share that prosperity with America and Japan.

MODERN DEVELOPMENTS IN METALLURGY.

(1) *Ingots and Ingot Moulds.* By A. W. Brearley and H. Brearley. Pp. xv+218. (London: Longmans, Green, and Co., 1918.) Price 16s. net.

(2) *Industrial Electro-metallurgy, including Electrolytic and Electro-thermal Processes.* By Dr. E. K. Rideal. Pp. xii+247. ("Industrial Chemistry.") (London: Baillière, Tindall, and Cox, 1918.) Price 7s. 6d. net.

(1) THE authors of this book are respectively the steel-maker and works manager at one of the large Sheffield steel works, and their book is dedicated to the workmen in appreciation of their efforts to reach the ideal in actual work. They state that a considerable part of it was prepared for teaching purposes, and that the manuscript sheets have been freely criticised by men whose business it is to make steel ingots. As they point out, there is no way of studying the conditions which lead to the production of good and bad ingots more instructive than that of making ingots themselves, according to well-defined variations of the processes of ingot-making, and cutting or breaking them in order to observe their qualities. In former days a good opportunity for such observations was enjoyed at negligible cost by the crucible steel melter, when ingots were "topped" down until the pipe or other evidences of unsoundness were broken away. Such a man knew what the conditions of casting were; he was familiar with the state of the ingot mould; he saw daily perhaps from twenty to forty ingots "topped" down to nearly half their length, and his eye was trained to notice minute differences in the appearance of the fractured surfaces. Such opportunities scarcely exist to-day, because ingots are only rarely "topped."

Undoubtedly the most trustworthy way of ascertaining the changes which occur in the casting, freezing, and cooling of steel ingots would be to experiment with the steel itself. Such a method, however, involves a costly plant and an expensive material which would require handling by an experienced person. The authors, therefore, set about discovering a material which is considerably more manageable, and they finally fixed on stearin wax, which, they maintain, exhibits a close resemblance to steel in much of its behaviour. They say: "With a few pounds of stearin, a pan of water, a beaker, a Bunsen burner, a spirit lamp, a few tin moulds, and a lot of patience, a great number of observations can be made to illustrate, extend, and also in some respects to correct prevailing notions about steel ingots"; and one of the objects of their book is to commend the use of stearin for teaching purposes and to show how it may be applied to elucidate many of the difficulties relating to ingots and ingot moulds. By its aid they have studied the formation of pipe and secondary shrinkage cavities, the influence exerted on these by the shape and dimensions of the mould, the advantage or otherwise of feeder heads, the influence of casting temperatures on the soundness and strength of the ingots, and the location and effects of segregation. Their use of stearin has been freely criticised by other steel experts, but it appears to the present writer that the authors realise the limitations of the use of this material, and it is difficult to be otherwise than favourably impressed by the confession in their preface that they are "less confident than formerly that they are qualified to elucidate the art of ingot-making."

The book deals with the following subjects: (1) Crystalline structure and its effects; (2) shrinkage and contraction cavities; (3) casting temperatures; (4) ingot moulds; (5) methods of casting; (6) sound ingots; (7) blowholes; (8) segregation; (9) slag occlusions; (10) influence of ingot defects on forged steel. It is well written, plentifully illustrated, and deserving of careful study by those who desire to familiarise themselves with the subject.

(2) Dr. Rideal's book gives in succinct and well-written form an outline of modern industrial electro-metallurgy; in fact, the scope of the work is even wider than the title suggests, for three out of its eight sections deal with products which are not metallic. After a brief scientific introduction the author deals with electrolysis first in aqueous solutions, and then in fused electrolytes. Then follows a brief section on the electrolytic preparation of the rarer metals, succeeded by one on electro-thermal processes, in which, as the title indicates, only the heat generated by an electric current is used in the extraction of the metal. After this comes a section on the preparation of carborundum, and the oxy-silicides of carbon, the carbides, and the electro-thermal fixation of nitrogen by metals and metallic compounds. The concluding section deals with iron and the ferro-alloys. Electro-metallurgy has undergone very important technical developments in recent years, and Dr. Rideal is to be warmly commended for his attempt to indicate the limits and the possibilities of the application of electrolytic and electro-thermal methods in the industry.

H. C. H. C.

A NATURAL HISTORY OF PHEASANTS.

A Monograph of the Pheasants. By William Beebe. In four volumes. Vol. i. Pp. xlix+198. (Published in England under the auspices of the New York Zoological Society by Witherby and Co., London, 1918.) Price 12*l*. 10*s*. per volume.

THIS stately volume is the first of four to be devoted to the life-histories of the beautiful and interesting birds included in the pheasant family. Its outstanding merits are the beauty of its plates, which are charmingly reproduced direct from drawings by the best bird artists of the day, the extensive series of photogravures engraved from the author's photographs of the haunts of the various species, and the graphic and popular descriptions of their habits from studies made amid their native wilds. These and other features render the work far in advance of all other books written on the subject, and make it welcome alike to the ornithologist, the aviculturist, and the sportsman.

In order to carry out the author's ideals of what a monograph should be, an expedition was organised to visit the metropolis of pheasantdom in temperate and tropical Asia, where, in Ceylon, India, Burma, China, Japan, the Malay States, Borneo, and Java, seventeen months in all were spent. That such an expedition should have been possible was due to the generosity of Col. Anthony R. Kuser, of Bernardsville, New Jersey, to whom and his wife the work is fittingly dedicated. But this is not all. With the view of supplementing first-hand knowledge, Mr. Beebe visited a number of the leading museums in Europe in order to study specimens in their cabinets and to consult their libraries.

The scope of the work may well be described as exhaustive. The introduction embraces a general account, including the historical aspect of the subject from the earliest times, classification, distribution, comparative abundance, voice, flight and gait, daily round of life (food, roosts, friends and foes), protective coloration, home life, and relation to man. Under the last heading it is distressing to learn that even in their remote haunts amid the highest mountains of the Old World these birds, mainly from the remarkable beauty of their plumage, are rapidly becoming extinct through persecution. Mr. Beebe tells us that for many years they have paid a heavy toll to the millinery trade. It is known, for example, that some years ago 45,000 Impeyan pheasants had been slaughtered; Mr. Beebe himself has seen huge bales of feathers of the silver pheasant, and Nepal and China still export large quantities. Now that the Chinese have adopted a meat diet, pheasants are no longer immune, save where Buddhists and Hindus hold sway, and they are everywhere trapped, snared, pierced with poisoned arrows from crossbow or blowpipe, or slain by repeating shot-guns. It is gratifying to know that in the British-governed regions they are protected by well-regulated game laws, and the brooding hens and chicks are free from persecution. In this connection it is important to learn that the birds do very little damage to crops, and when they appear among them it is insect life which is the main attraction.

As regards the classification of the family, the grouping of the numerous genera under sub-families has never been satisfactory. Mr. Beebe, however, after much careful study, discovered a new character—namely, the "regular sequence in the moulting of the tail feathers," which holds good throughout the life of the bird, and agrees also with "assumed relationships which had hitherto been taken for granted." The following are the sub-families adopted: Perdicinæ, Phasianinæ, Argusianinæ, and Pavoninæ; and the various genera grouped under them are indicated. Since our author includes the Perdicinæ in his scheme, yet treats of only two of its genera, namely, Ithagenes and Tragopan, omitting many others, the work can scarcely be regarded as a complete treatise of "The Pheasants of the World." It will deal, however, with nearly one hundred forms.

The systematic treatment of the subject is on the same exhaustive lines. The volume already issued treats of twenty-one species: the blood pheasants (Ithagenes), the Tragopans or horned pheasants (Tragopan), the Impeyans (Impeyanus), and the eared pheasants (Crossoptilon). For each of these species are given the generic and specific characters; scientific, English, native, French, and German names; full descriptions of the various stages of plumage, moults, variation, hybrids, parasites, internal anatomy, characteristics as observed in their haunts, geographical distribution, migrations, food, nests and eggs. It is embellished with twenty-two coloured plates by Messrs. A. Thorburn, G. E. Lodge, C. R. Knight, and H. Gronvold, fifteen photogravures, and five maps. The volume is sumptuous in all respects except the binding, which does not come up to the standard of the rest.

While Mr. Beebe's fine work merits the highest praise, it is greatly to be regretted that its price (50*l.*) places it beyond the reach of the vast majority of those who would appreciate and use it.

W. E. C.

OUR BOOKSHELF.

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., 1918.) Price 12*s.* 6*d.* net.

EVERY mathematician will welcome this new edition of a classical work if only as an indication that the demand for it has not diminished since it was originally published, forty-six years ago. Although the modern tendency is away from the excessive zeal for examples and exercises of a past generation, the mathematical student will derive much benefit from excursions on this "very pleasant path, on which he may exercise in an agreeable way all his mathematical limbs," especially as curve plotting is a necessity in all branches of modern science. A valuable feature of the book is the sketch of the inverse process of finding the equation of a curve the graph of which is given. Further work on this branch of the subject would be very useful.

This is the first revised edition; the second and third issues were mere reprints of the first edition. The editor has discharged his duties with restraint, and he has introduced several improvements. The printing is more compact and the use of leaded type conduces to comfort in reading. Additional explanatory matter has been inserted occasionally, and the examples have been much improved by the inclusion of hints for their solution. In one or two places the clearness of the original is somewhat marred, as, *e.g.*, on p. 91, where two different notations are used simultaneously. It is not always obvious why formulæ have been banished from the text to separate lines, and *vice versa*; but this is a question of taste. The plates have been touched up here and there, and occasionally corrections have been made, *e.g.* ix., 3, 5; xiv., 10, 18.

It is surprising that the editor has retained the definition of curvature as measured by the *diameter of curvature*, whilst in at least one place he has used the first person in an interpolated remark.

The index and the classified list of curves are welcome additions. S. BRODETSKY.

An Account of the Crustacea of Norway. With short descriptions and figures of all the Species. By Prof. G. O. Sars. Vol. vi., "Copepoda, Cyclopoida." Parts 9–14. Pp. 105–225 + 54 plates. (Bergen: Published by the Bergen Museum, 1915–18.)

WITH the issue of the six parts noted above, Prof. Sars concludes the sixth volume of his great work on the Crustacea of Norway, the third of the series to be devoted to the rich and varied group of the Copepoda. This volume deals with the division Cyclopoida, which includes, for the most part, bottom-haunting species, many of them parasitic or semi-parasitic. Like the Harpacticoida treated of in the preceding volume, they are rarely found in the plankton, and must be sought for by special methods of collecting demanding much skill and patience. For this reason they have received far less attention than the relatively few species that are captured in bulk by the tow-net, and the proportion of novelties described in these volumes is very high. It is scarcely too much to say that Prof. Sars is giving us, for the first time, the means of forming a just impression of the Copepoda as a whole, both as regards their structural diversity and their habitats and distribution in northern seas. The species living in fresh water were previously better known, but here also Prof. Sars's accurate drawings will greatly facilitate the identification of species.

Apart from the faunistic value of the work, however, the iconography which it provides for many groups hitherto sadly in want of illustration will be of the greatest value to the morphologist and taxonomist. Among the numerous points of interest touched on in the parts under review, it may be noted that Prof. Sars revives Thorell's group of the Poecilostoma, although in a restricted sense and a subordinate position. In doing so he discards Claus's interpretation of the mouth-parts and reverts to that originally given by Thorell, according to which the mandibles, elsewhere so persistent, have entirely disappeared in the species composing this aberrant group.

W. T. C.

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 Perception of Sound.

I REGRET that I overlooked Prof. Bayliss's letter in NATURE of October 17, in which he made an appeal for my opinion. But, if I rightly understand, the question at issue seems to be mainly one of words. Can we properly speak of the propagation of sound through an incompressible fluid? I should answer, Yes. There may be periodic motion and periodic variation of pressure; the fact that there are no variations of *density* seems immaterial. Consider plane waves, corresponding with a pure tone, travelling through air. In every thin layer of air—and thin means thin relatively to the wave-length—there are periodic motion and periodic compression, approximately uniform throughout the layer. But the compression is not essential to the travelling of the sound. The substitution of an incompressible fluid of the same density for the gas within the layer would be no hindrance. Although there is no compression, there remain a periodic pressure and a periodic motion, and these suffice to carry on the sound.

The case is even simpler if we are prepared to contemplate an incompressible fluid without mass, for then the layer need not be thin. The interposition of such a layer has absolutely no effect, the motion and pressure at the further side being the same as if the thickness of the layer were reduced to zero. To all intents and purposes the sound is propagated through the layer, though perhaps exception might be taken to the use of the word *propagation*.

As regards the ear, we have to consider the behaviour of water. From some points of view the difference between air and water is much more one of density than of compressibility. The velocities of propagation are only as 4 or 5 to 1, while the densities are as 800 to 1. Within the cavities of the ear, which are small in comparison with the wave-lengths of musical sounds, the water may certainly be treated as incompressible; but the fact does not seem to be of fundamental importance in theories of audition. RAYLEIGH.

Terling Place, Witham.

The Common Cause of Pure and Applied Science.

A GOOD deal of anxiety has been expressed recently in various quarters lest the great interest now being evinced in applied science may perpetuate, or even aggravate, the national neglect of pure science. As I do not share this anxiety, but, on the contrary, am strongly convinced that exactly the opposite effect will ensue; and as there seems to be some danger in the attitude that is being assumed by certain of my friends, I should like, with great respect, to ask for attention to the considerations which have led me to these opinions.

For many years past there has been in this country what the late Lord Armstrong once well called "a vague cry for technical education," a dim feeling on the part of the industrial world, collectively speaking (there have, of course, been brilliant individual exceptions), that there was some business-end of science that was worth getting hold of, and that should be got on easy terms of talent, time, and money. We know what it has failed to produce in institutions, in individuals, and in industrial efficiency; and we knew it would. My working life has been passed in a great industrial region where this faint-hearted belief in the utility of science has been the one real obstacle to the progress of good science of every kind. At Leeds I have occupied myself greatly with the promotion of applied science, as in duty bound. But it has also been in the sure and certain hope that applied science, worthy of the name and really worthy of acceptance by industry, was indissolubly linked in bonds of mutual benefit to the purest and highest science that was ever dreamed of even by my chemical brethren, whose unworldly "stinks" profane the cloisters of more sequestered seats of learning.

It has been a hard fight, and though it would be unjust to say there have been no gains, I long since came to the conclusion that nothing short of a national cataclysm was likely to bring about anything approaching the change of heart that was so desirable and so necessary.

The cataclysm of war has, in fact, done this great thing for science. There is indisputable evidence of it, and I believe that at last British industry is generally, not exceptionally, on its way to use science well. That being so, I ask: Is there any possible escape for British industry and the British public from promoting pure science, and promoting it handsomely? I do not see it. Of course, they will not begin by endowing professorships in radio-activity or relativity, nor yet, perhaps, in that very pure chemistry which is the dearest thing to me; but they will be obliged to do it, and to do it before long. In the first instance, they will ask for what they now know they want: first-rate men who can apply science to the practical problems of industry. Already to a large extent they know that such men must have in them the root of the matter in the form of real scientific knowledge and skill, and it will follow as the day the night (if you so regard it) that science, pure and simple, must also be the object of their self-interested or patriotic solicitude.

I, for one, shall be glad to have it on those terms. For what, let us frankly say, are the alternatives for pure science? One I have just tried to set forth; the other, it seems to me, is a direct appeal for pure science, either because it is pure or because it is useful. If you extol it because it is pure, it is a worthy effort that I should honour with all my heart on one condition, and that is that you should avoid the incalculable mischief of trying to make out that there is in essence any distinction between pure and applied science, or that you should give just cause for the belief that there exists a brotherhood in science who set themselves up as the elect and disdain the implications of science in the practical arts that serve and preserve mankind.

If you extol pure science simply because it is useful—which by hypothesis you do not want to do—you embark on the task, long since essayed and long sustained, of teaching people by exhortation what at last they are in the way of finding out surely for themselves. To do that runs counter to all the precepts I have drawn from my experience of teaching.

I know very well what it is to be a prophet of pure science, even if only a minor or a minimus one, crying in the wilderness, and believe I can enter somewhat into the feelings of the major and maximus ones who are anxious and impatient under the present aspect of affairs. But they may be asked earnestly to consider the other point of view also, and to bethink themselves whether, after all, a great deal of the Philistinism of our people is not due to the detachment of locality, of interest, and of intercourse that in the past has been justly chargeable to the world of learning.

The British Association for the Advancement of Science was founded for the purpose of bringing a knowledge of science, its glories and its uses, among the people. It has done a great work, a much greater work than is known to those who will not sacrifice a week of the Alps or the oceans to do their bit and to experience the stimulus and profit derivable from the meetings—chiefly, it must be admitted, outside the section-rooms. The British Association needs revitalising, and I believe it can be revitalised. If our men of science would rally to it, it might do much that seems either to be neglected or to be falling into the hands of new organisations, the number of which alone, to say nothing of their particular distinctions or their subscriptions, is becoming quite bewildering.

It is, of course, the British way to have a multiplicity of disconnected organisations doing, or trying to do, much the same thing. We have won the war (it is true some others "also ran"), and Britain is justified in her institutions. To that no one subscribes more heartily than I, but we made some mistakes; and though organisation in the German way may be the mental path to inhumanity if followed far, I think we might profit by using a little more co-operation as we go our several ways.

Chemistry, it has been said, is a French science. Be that as it may, the immortal Lavoisier, who did more than anyone to revolutionise chemistry, began to investigate combustion because he was interested in lighting the streets of Paris. So at least says M. Le Chatelier, who is, I think, a chemist *assez pur*. According to my reading of history, so much pure science has arisen, not from the heavens above, but from the earth earthy beneath, that I will never, if I can help it, be penned off by any principality or power from the fraternity of applied science. Besides that, I owe them personally more than can ever be acknowledged for heading me off certain great dangers that threaten the academic life, and for helping me in countless ways with the promotion of pure science. We may rejoice without reserve in their temporary monopoly of popular favour.

Arthur Smithells.

The Theory of Hormones Applied to Plants.

No one would have read Prof. Bayliss's review (Nature of December 12, p. 285) of Dr. Jacques Loeb's experiments on the "chemical correlationship" in plant growth with greater interest than John Hunter, for he had carried out many experiments on growing beans to elucidate the phenomena which are now explained on the theory of hormones. Hunter was familiar with phenomena of a similar kind in animals, and his experiments on plants were made primarily to elucidate that mysterious mechanism which went in Hunter's time under the name of "sympathy." An account of Hunter's experiments, carried out between 1772 and 1790, will be found in "Essays and Observations by John Hunter," edited by Sir Richard Owen, and published in 1861 (vol. i., p. 367). These observations were saved from destruction by William Clift.

Arthur Keith.

Royal College of Surgeons, London, W.C.

RESEARCH ASSOCIATIONS AND OTHERS.

RESEARCH is the cry in every direction, but the public still needs instruction as to what it means and the conditions requisite for progress. Discovery of new principles on which advance can be made in the fundamental knowledge of Nature will probably be accomplished in the future, as in the past, through the genius of the few gifted men, but the dissemination of the right kind of knowledge and the creation of a widely diffused sentiment of respect for science and for scientific work depend largely on the future education of the people generally. Since it will probably always be true that public opinion is dependent more or less on authority, the action of the Government in setting up the Department of Scientific and Industrial Research is a step of the utmost importance. The work done by this body so far, however, relates to direct applications of science to practical purposes as revealed by the report for 1917–18 noticed in NATURE for October 17 last.

The protection of the interests of pure science, regardless of immediate utilitarian application, is, however, a matter of serious importance, and a movement has been set on foot at Cambridge with this object in view. The "Scientific Research Association" has been formed, and has put forward a scheme for its organisation and functions which at first sight appears not only very comprehensive, but also somewhat complicated. It is believed that science requires larger endowments and more co-ordinated and informed allocation of those endowments than is provided by any existing machinery. It is intended, therefore, to institute a comprehensive system of intelligence as to the research that is actually being done in the various branches of science, and of new research as it is projected. By those who are familiar with the position of workers in science in the past, how largely the work done has been accomplished at the cost in time, labour, and money of private individuals or in the scanty leisure of professional men, it will be agreed that if the national life is to be increasingly vitalised and the scientific habit of mind cultivated, it is essential that an assured career should be open to the competent worker. It is, therefore, proposed to formulate an extensive scheme of endowment of research by the State which would afford inducements to the most promising students to continue their pursuit of scientific investigation. This means an addition not only to the grants now made to universities, but also to the various schemes now afloat for providing maintenance scholarships and fellowships on a more extended scale. It is not proposed to advocate the separation of teaching and research, which have been hitherto associated in so many institutions with advantage to both.

Finally, the association contemplates taking a leading part in impressing on the public the importance of scientific research in all its aspects, and the fundamental value of scientific method in every department of national life. A very strong list of supporters has already been got together, but an examination of the list reveals the fact that, so far, for reasons which are not obvious, the promoters have not succeeded in getting the co-operation of some of the most eminent men of science in their several departments. For example, the president and other officers of the Royal Society are conspicuous by their absence, and as the president is one of the most famous physicists in the world, and Master of Trinity besides, he could not have been overlooked in connection with any scheme originating in Cambridge.

The fact is probably that while the time is certainly ripe for movement in the direction indicated by the proposed association, the scheme as at present formulated requires time and further consideration to secure the complete approval and adherence of all the leading men of science of the country. Moreover, complete concurrence in any one scheme is scarcely to be expected as yet while sympathy is so much divided by the various proposals which are in the air. The endowment of research will have to be further considered by the Government, though it is possible that in view of the money placed at the disposal of the Committee of the Privy Council for Scientific and Industrial Research, and the assignment of 100,000*l.* for research in connection with dyes, some people may feel that it will be well to watch the effects of this, and of other sources of endowment like that of the Salters' Company mentioned in NATURE for October 24, before proceeding further. It is true that there is in this country no institution corresponding with the Kaiser Wilhelm Institut near Berlin, or with the Wolcott Gibbs Institute at Harvard, but the establishment of a new college does not apparently enter into the programme drawn up by the promoters of the association. The Royal Institution with its connected Davy-Faraday Laboratory is unique in both constitution and output of results. It must not be forgotten, moreover, that nearly all the British universities have adopted a scheme for the institution of degrees open to candidates from overseas to be awarded on the results of research work performed by the candidate, and probably this will lead to further demands for assistance to these universities.

In the meantime the idea of bringing together the whole body of British men of science has resulted in the formation of another association under the name of "The National Union of Scientific Workers," concerning which a letter appeared in NATURE of October 24. The draft rules declare that the object of the union shall be, in the first place, "to advance the interests of science, pure and applied, as an essential element in the national life." The second object is "to regulate the conditions of employment of persons with adequate scientific training and knowledge, and their relations to their employers and to other employees," and among other things to set up a register of trained scientific workers and to establish an employment bureau. The promotion of scientific research is also mentioned, but it appears that the union assumes more the character of a professional body acting somewhat in the trade-union spirit than an association of persons interested in the promotion of scientific education and research. It will be evident, therefore, that the National Union would be unlikely to obtain much financial support from the public for the promotion of research, whereas an organisation like the Scientific Research Association may do so.

There is evidently a certain amount of overlapping in these movements. There has been formed within the last few months in the North of England an Association of Chemists with a similar professed purpose, but this has been merged, at least so far as the principal leaders are concerned, in the Institute of Chemistry, the chartered body to which nearly all the well-qualified chemists in the country are gravitating. But another step is now being taken in the creation of a Federation of Chemists which will include not only the highly qualified, but also men of all grades, and this will probably assume the features of a club with libraries and meeting-rooms. Science is evidently not going to be overlooked, but it would be unfortunate if any serious dissipation of energy should ensue before such compromises can be effected which will provide for the needs of all branches of science, pure and applied, and especially those cases in which, as between the chemists, metallurgists, and engineers, mutual help and recognition are most desirable.

THE FUTURE DEVELOPMENT OF THE INTERNAL-COMBUSTION ENGINE.

A BRILLIANT piece of analytical work has lately been given by Mr. H. R. Ricardo to the North-east Coast engineers and shipbuilders.[1] Mr. Ricardo takes as the title of his paper "High-speed Internal-combustion Engines," and in it he compares the modern high-speed engine with the older slow-speed type, much to the disadvantage of the latter—not merely in relation to speed, but also in respect of the degree of skill shown in design. There is great force in the arguments used, and the truth which is evident in not a few of them may legitimately be regarded as one of the outcomes of the war. The war had the effect of drawing out and stimulating the hitherto hidden abilities of numbers of energetically minded and scientifically trained engineers—mainly quite young men—who in the highly inelastic system of pre-war days received but trifling encouragement for either their inventive or their organising powers. The State cared little for scientific or technical research, and the leaders of industry were in too many cases quite as conservative as the State. Then came the awakening. The perils and dangers of war required that, for the supreme cause of the safety of the State, this attitude should be completely reversed—and reversed it was. Wide scope was at once given to all with inventive and scientific ability. One result we see in the amazing strides made in aviation—mainly the work of youth. When, therefore, Mr. Ricardo compares the older types of internal-combustion engine with the aero-engine of to-day he is comparing not merely two engines, but also two systems, two worlds in fact—one where the State is little concerned what technical developments its nationals may or may not produce, and one in which the State, fighting for its life, calls anxiously for the help of all talent to be found anywhere within its borders.

[1] Transactions of North-East Coast Institution of Engineers and Shipbuilders, vol. xxxiv., October, 1918.

But for the war aviation could not have developed at a pace in the least approaching that actually attained—and steadily maintained. This development is, as regards both numbers and efficiency, the outstanding technical achievement of the past four years; naturally it has demanded intensely rapid, even drastic, changes in the power unit of such craft. The heavy loading put on such engines has caused their design to be far more difficult than that of other internal-combustion engines; they may be required to run at high power (and that involving unprecedentedly high brake mean pressures) for so long as twenty hours on end. Types which have been constructed to weigh but two or three pounds per horse-power and yet run for hours on full load will afford a magnificent start to the aerial services of peace, especially since the less strenuous specifications of future operations will allow the engine to operate normally at powers quite appreciably below the maximum. The modern aero-engine is close to the highest perfection possible for its power and cycle. Any material further advance must, it would seem, be by change of cycle, change of fuel, or perhaps a break away to some new kind of prime mover altogether.

Mr. Ricardo correctly points out that "the design of internal-combustion engines in this country has during the last twenty years proceeded along two widely different lines directed by separated schools. On one hand, we have the designers of what may be termed the slow-speed type of engine, who have consistently had to compete with, and have based their designs upon, steam-engine practice; and, on the other, we have the designers of small high-speed engines who have appeared with the advent of the motor-car. The latter have created a school of thought of their own, and have developed along lines which are distinctly enterprising." The difference between high- and low-speed engines is by no means confined to a matter of speed, since the former usually run on petrol and the latter on gas. This difference in fuel is very important, though perhaps not permanent—a small "suction producer" added to a "petrol engine" would enable the latter to be run on gas directly derived from coal fed into the producer. This may come, but it seems to be some way off at present.

The difference between the use of petrol and gas is not merely one of supply and carriage, but is also of a more essential nature. Petrol has certain very valuable advantages. For one thing, a gas mixture suffers a chemical contraction on combustion, whereas a petrol mixture shows an expansion; the evaporation of petrol in the carburettor lowers the temperature of the incoming charge, so that the weight-volumetric efficiency of the suction stroke is higher than with gas. The disadvantages of petrol are less pronounced, though they certainly exist; thus there is usually some proportion of petrol which is not properly vaporised, and escapes combustion; and a stricter limitation of richness of charge is necessary.

These essential differences tend to complicate any comparison of the usual high-speed with the usual low-speed engine. Mr. Ricardo suggests that piston design in particular is looked on from such different angles by the two schools as to lead to very marked differences in engine types. A heavy piston means high inertia forces at the beginning and end of each stroke; this means a stout connecting-rod; both these in turn call for a strong and heavy crank requiring massive bearings, and at once we are led to the ordinary gas-engine of pre-war days. The aero-engine has developed a piston suitable for heavy loads and high speeds. It is surely unlikely that designers of other types of internal-combustion engine will fail to draw the obvious conclusion.

The war may be expected to leave its mark on internal-combustion engine design in two ways: first, by greatly lightening the motor-car engine, so that its weight per horse-power may not compare so unfavourably with that of aero-engines; and secondly, by making the slow-speed stationary, or nearly stationary, gas- or oil-engine a much less cumbrous machine.

Evolution in engine practice has long been towards ever-increasing speeds. The old beam-engines of the early part of last century gave place to an engine of much higher speed with hundreds, instead of tens, of revolutions per minute. The higher speed meant, for equal horse-power, less total force on the piston, hence a less diameter of piston, a smaller and lighter engine. Now again we find this same evolutionary process at work—piston speeds are rising and the weight per horse-power ratio grows less.

In view of the specially intense interest which the agricultural industry will have for humanity during the next term of years, it is important to consider how far our recent increase in knowledge of the potentialities of the internal-combustion engine may be harnessed to this work. Ford in America has done much—but mainly on what may be termed pre-war data. Much remains to be done in this coming post-war period. High piston speeds, light reciprocating parts, and the use of high-grade steels should, combined, produce an agricultural machine as efficient for its purpose as the motor-car and aeroplane have become. The annual output of high-speed internal-combustion engines in this country is at present at the rate of some 10,000,000 h.p. annually. A large part of this has been for air work; a smaller fraction will suffice now. Here is to be found a great opportunity for the internal-combustion engine in fresh enterprise in new fields.

H. E. W.

NURSING HABITS OF ANTS AND TERMITES.

A RECENT paper by Mr. W. M. Wheeler, in the Proceedings of the American Philosophical Society, Philadelphia, gives some interesting details of the behaviour of certain ants in the care of their offspring. The larvæ of the primitive subfamily Ponerinæ are fed, not, as in the case of the most highly specialised ants, with food regurgitated by the workers, but with fragments of insects. Speaking of a species of this subfamily common in central Texas, Mr. Wheeler says:—

> These larvæ are placed by the ants on their broad backs, and their heads and necks are folded over on to the concave ventral surface, which serves as a table or trough on which the food is placed by the workers.

In the case of another species, as soon as the food is in place it is sometimes covered by the larva with a copious discharge of a secretion containing a proteolytic ferment, by means of which the food undergoes extra-intestinal digestion. Mr. Wheeler adds the curious observation that this liquid is eagerly lapped up by the nurses.

The larvæ of four species of ants belonging to the subfamily Myrmecinæ were collected by Mr. Lang in the Belgian Congo. In three of these, remarkable exudatory appendages exist, some of which consist of a basal enlargement filled with fat-cells, and a slender, tubular distal portion containing a granular liquid which the author thinks can only be interpreted as an exudate derived from the fat-cells, and capable of being filtered through the cuticula of the appendages by means of the pressure exerted by an elaborate system of muscles. That the chitinous envelope of these structures is not necessarily impervious to the passage of a secretion is shown by the researches of Holmgren, Biedermann, Kapsov, Casper, and others. From the ontogenetic and phylogenetic history of these appendages, and especially from the fact that they appear to be developed in inverse ratio to the salivary glands used in extra-intestinal digestion, Mr. Wheeler concludes that their secretion, like that of the salivary glands in the Ponerinæ, is capable of furnishing nutriment to the nurses, the benefit of the feeding habit being therefore reciprocal. This conclusion he considers to be supported by the observations of Wasmann on the Staphylinid beetle *Xenogaster inflata,* which inhabits the nests of termites. In this larva the fat-body produces an exudation which, after passing through a layer of hypodermis, reaches the surface through the cuticle. Similar phenomena are present in other beetles and Hymenoptera which frequent the nests of ants or termites, as recorded by Trägårdh; while Holmgren has found that, quite apart from their guests, termites feed to a large extent on the exudation furnished in different degrees by the several castes of their own species.

For this reciprocal feeding, whether within or without the limits of the same species, Mr. Wheeler proposes the term "trophallaxis." The practice has, he considers, an important bearing on the substitution of the social for the solitary habit in various species of Hymenoptera. The various trophallactic relations existing in communities of ants are grouped by him as follows: (1) Trophallaxis between mother or adult worker and larval brood; (2) between adult ants (mutual regurgitation); (3) between ants and true guests; (4) between ants of different species. Besides these reciprocal relations there is the ordinary trophic connection between ants and other insects outside the nest (as aphides and certain Lepidopterous larvæ), and also between ants and various plants known as Myrmecophytes.

The author takes occasion to combat Wasmann's view as to a special symphilic instinct in ants and termites. The latter observer adduces certain ascertained facts regarding *Lomechusa strumosa,* a beetle parasitic in the colonies of *Formica sanguinea.* The adult beetles are fed and licked by the ants, but the beetle larvæ devour the larvæ of their hosts; moreover, in some colonies the presence of the parasite leads to the development of pseudogynes—*i.e.* forms intermediate between workers and females, which are incapable of performing the functions of either caste. The infection of an ant colony by Lomechusa is therefore presumably detrimental to the hosts. This is admitted by Wasmann, who nevertheless contends that *Formica sanguinea* has acquired a special symphilic instinct, not under the influence of natural selection, but in connection with the use of a process analogous to artificial selection as practised by man. Mr. Wheeler holds, on the other hand, that the beetle is the aggressor, and that the fact that it is licked and tended by the ants is a mere incidental result of the nursing habits of the latter with regard to their own offspring. F. A. D.

PHYSICS IN SCHOOLS.[1]

In opening the discussion described in the report before us, Prof. C. H. Lees, president of the Physical Society, stated that the meeting was the outcome of the desire of the society to help those engaged in science teaching in public and secondary schools to carry out the extension of their work which will probably ensue in the course of the next few years. We may begin our notice of the report by congratulating those responsible for the idea of such a meeting and those to whom the credit of its skilful organisation belongs.

Sir Oliver Lodge opened with a characteristically direct remark:—"Mr. President, I very much agree that it is desirable that the average man should know more physics than he does at present. He could hardly know less." But the speaker did not pursue the delicate question as to the responsibility for this state of things, whether the average man or the teacher of physics is to blame. Nor need we inquire, since the one clear, unmistakable inference from the discussion as a whole was that teachers of physics are tackling with much thoughtful energy the problem of providing courses of physics which will suit those who will get in schools the only knowledge of physics they are ever likely to possess.

It is worth noting that Sir Oliver Lodge considers it best to begin with the biological sciences, for cultivating the faculty of observation. Why this should be so was not explained; nor was anything said as to how the power of observing gained in natural history studies was to be transferred to the field of physics. Here we touch on the weak side of the discussion—there was too insecure a basis of psychological knowledge, too little recognition of the imperative primary need to find out how the boy's mind will work with spontaneity as well as under discipline.

There are several clear statements in this report on the distinction between physics for the boy who will specialise in science and "Physics for All," the contribution of Prof. R. A. Gregory being particularly clear and weighty. The need for inspiring courses was well emphasised by both the opening speakers; the Harrow syllabus submitted by Mr. C. L. Bryant was an able effort to meet this need.

Every schoolmaster feels one great difficulty in carrying out his ideals, viz. the narrow limits of time within which his work has to be carried out. Dr. T. J. Baker brought this point clearly before the society, and from this point of view criticised the recommendation of Sir J. J. Thomson's Committee to lower the school-leaving age from nineteen to eighteen. Probably the majority of schoolmasters, not excluding Dr. Baker himself, would be satisfied with an "Advanced Course" which ended with the end of the school year in which the age of eighteen was reached.

Mr. A. T. Simmons showed the further difficulties which arise when the school course ends at sixteen. Too often electricity and magnetism are left out, so far as the majority of the boys are concerned—a serious matter. We may point out that this means not merely the loss of a study of fascinating interest to most boys, but the further result is that school-work and the life of the world remain divorced. Mr. Simmons did another service to the discussion by indicating things which could be left out with advantage; we suggest that one of the most necessary things to do at present is to scrap useless topics of the Nicholson hydrometer type.

If we take a longer view, it is obvious that for future progress the training of teachers of physics is of first-rate importance, and the remarks of Prof. T. P. Nunn will be read with interest. The two main theses were (1) the need for the teacher to have studied his subject critically, (2) the benefit which results from a sound apprenticeship to the teacher's art. We agree that "the way of wisdom with regard to training colleges is not to suppress or to ignore them, but to take serious pains to strengthen them for the better performance of their indispensable duties." In our opinion, the training of science teachers is one of the vitally important items of educational reconstruction, and this might well be impressed upon local education authorities during the coming year. The need for "refresher courses" for teachers who have been at work for several years, possibly in a remote school, has been recognised by the more progressive authorities; but such courses rarely include physics or chemistry. Mr. J. Nichol was only too well justified in directing attention to the financial difficulty of the science master who wishes to keep up to date (this applies especially to those whose school is

[1] "The Teaching of Physics in Schools." Report of a discussion at a meeting of the Physical Society, June 14, 1918. Pp. 43. (London: Fleetway Press, 1918.) Price 1s. 2d. post free.

far from a large town), and he was on equally sound ground when he urged that the teaching of physics should be revivified and kept in touch with everyday life, so as to defeat any attempt to standardise it and use it merely as a training in logical method (*cf.* Euclid).

The meeting was saved from the peril of a tame unanimity by a difference of view as to approaching the subject synthetically, *e.g.* by building up a theory of heat from observations of the dissected phenomena of expansion, etc., or analytically, *e.g.* by starting with a steam-engine and inquiring how it works.

The difference was somewhat unreal—at least, the real issues were not clearly defined. Surely the problem is how to harness the "wonder" and "utility" motives, and this has to be solved for each method-unit according to the characteristics of each class and teacher and of the method-unit itself. Here it may be said that the existence of a method-unit was only once referred to, when Mr. F. B. Stead directed attention to the fault that the laboratory exercise that can be done in one lesson period tends to become the unit of teaching. We are of opinion that teachers should give more attention to sectioning their subject into natural method-units, using them for revision, for the pupil's more elaborate note-taking, and for essays. Perhaps the simplest example is "expansion by heat," which is so obvious that in practice regard to this topic as a method-unit is fairly well observed.

It is not possible within the limits of this article to refer to many useful practical suggestions which teachers may gain by reading this report. We have no doubt that many will be grateful to the Physical Society and to the speakers, not forgetting Dr. H. S. Allen, who organised the symposium. G. F. D.

NOTES.

THE mineral resources of Spitsbergen have lately been receiving much attention. The signing of the armistice has allowed the two British companies which hold the principal mining estates in that country to make plans for resuming operations. A correspondence in the *Times*, initiated by Prof. F. Haverfield, of Oxford, has dealt with the value of the coal and iron-ores. Prof. Haverfield, who seems to prefer the German spelling of Spitsbergen with a "z," quotes Swedish geologists as denying the existence of high-grade iron-ores, and he characterises the attempts to utilise Spitsbergen commercially as a long series of failures from the time of the Dutch onwards. In these respects he has been misinformed. The Dutch and English whalers, and later the Russian and Norwegian trappers, did a rich trade in Spitsbergen produce. Mining ventures have not always been successful, but cases of failure have been due, not to lack of mineral ores, but to ignorance of Spitsbergen, to lack of political control in the country, and, in some instances, to mismanagement and amateur effort. During the war various Norwegian and Swedish companies, in several cases trespassers on British estates, mined large quantities of coal. This year about 100,000 tons of coal were sent to Scandinavian ports. It is merely a question of effort to make Spitsbergen one of the chief coal-producing countries in Europe. The accessible coal-fields are estimated to have a content of at least 4,000,000,000 tons of good steam-coal. The iron-ore deposits have yet to be examined by competent geologists and mining engineers, but the samples brought to this country promise well. Other mineral resources include gypsum in enormous quantities, asbestos, copper-ore, oil shale, and probably free oil. The mineral prospects of Spitsbergen are great, but, with the exception of coal and gypsum, need to be thoroughly prospected by qualified men before commercial development can proceed. Meanwhile, it is essential that Great Britain should keep a watchful eye on the fate of this *terra nullius*, in which British subjects have the principal claims.

WITH the view of meeting the growing demand for technical literature, the council of the Chemical Society decided early in 1917 to increase the scope of the library of the society by a more liberal provision of suitable technical works and journals. It was also thought that by placing the existing library of 23,000 volumes and the proposed extension at the disposal of members of other societies and associations they might relieve themselves of the necessity of collecting and maintaining the literature relating to their special subjects, and assist in the formation of a representative library of chemical literature, such as would be difficult to obtain by individual effort. A conference of representatives of societies and associations connected with chemical science and industry was held to consider the means by which other societies, etc., might co-operate in this extension, and financial assistance was afterwards offered by the following societies, etc.:—Association of British Chemical Manufacturers, Biochemical Society, Faraday Society, Institute of Chemistry, Society of Dyers and Colourists, and Society of Public Analysts. Members of these contributing societies, etc., will be permitted to consult the library and borrow books from January 1, 1919. The hours of opening the library will be as follows:—Mondays, Wednesdays, and Thursdays, from 10 a.m. to 6 p.m.; Tuesdays and Fridays, from 10 a.m. to 9 p.m.; and Saturdays, from 10 a.m. to 5 p.m.

IN the *Fortnightly Review* for December "Fabricius" refers to the manifesto in support of Germany's policy and action relating to the war signed by ninety-three university professors in that country in 1914, and widely distributed. Among these professors were several occupying scientific chairs, and they must share the righteous condemnation which has been given by the intellectual world outside Germany to their misuse of authority on behalf of dishonourable dreams of conquest. As, however, most of the signatories of the manifesto were representatives of theology, law, literature, and like branches of knowledge, and not of science as it is usually understood, it is misleading to refer to them as a group of "scientists," as "Fabricius" does in the following extract from his article:—"Scientists are supposed to devote themselves to the promotion of science and of truth, for science is incompatible with untruth. However, the unceasing advocacy of a robber-policy and the exaltation of a robber-morality had so completely destroyed the instinct of responsibility and of truth amongst Germany's intellectual leaders that ninety-three of Germany's most eminent scientists, among them many prominent theologians and legists, disgraced themselves and German science for all time by issuing in 1914 a manifesto to the world in which they mendaciously proclaimed that the other Powers had forced a war upon innocent and peaceful Germany; that upon France, England, and Russia rested the blood-guiltiness; that Germany fought a clean war of self-defence." We note that the Brussels correspondent of the *Times* reports on December 10 that the Belgian Surgical Society, at its first meeting since July, 1914, solemnly repudiated the notorious manifesto, and resolved to break off all relations with German men of science until the calumnies, especially against Belgian medical men, are publicly disavowed.

WE learn with regret of the death on December 9 of Dr. Reginald Percy Cockin, a member of the staff of the London School of Tropical Medicine. Dr. Cockin was educated at Caius College, Cambridge, and the London Hospital. After graduating in arts and medicine in 1906 he entered the Colonial Medical Service, passing "with distinction" in the qualifying course at the London School of Tropical Medicine. In 1908 he proceeded to West Africa, and saw active service as medical officer with the Cross River Expedition into the Munchi country. In 1910 he transferred to Cyprus as district medical officer, and held the post of examiner under pharmaceutical law. During 1913 Dr. Cockin was bacteriologist and resident surgeon at the Colony and Yaws Hospitals in Grenada. He then returned to the London School of Tropical Medicine, occupying successively the posts of demonstrator, assistant in the helminthological department, and assistant entomologist. In 1916 he inaugurated one of the venereal clinics under the Seamen's Hospital Society, and as its director and pathologist organised the clinic at the Albert Dock Hospital with brilliant success. Dr. Cockin's contributions to medical literature were chiefly clinical, dealing with yaws and its treatment, rat-bite fever, and ankylostomiasis. His M.D. thesis on "Ankylostomiasis in Grenada" was of special importance in definitely associating with this infection a series of hitherto obscure cardiac symptoms. Dr. Leiper writes:—"In him we have lost one of peculiarly charming personality, wide sympathies and interests. Knowing as he did the risk of overstrain, which actually proved fatal, he courageously discharged until within a day of his death, not only his own duties, but also those of others, away on active service."

A CHRISTMAS course of juvenile lectures will be delivered at the Royal Institution by Prof. D'Arcy Thompson on "The Fish of the Sea," beginning on December 31 at 3 o'clock. The following courses of lectures will be given before Easter:—Prof. Spenser Wilkinson, Lessons of the War; Prof. MacGregor-Morris, Study of Electric Arcs and their Applications; Capt. G. P. Thomson, The Development of Aeroplanes in the Great War and The Dynamics of Flying; Prof. Hele-Shaw, Clutches; Prof. Arthur Keith, British Ethnology: The People of Scotland; Prof. Norman Collie, Chemical Studies of Oriental Porcelain; Dr. W. Wilson, The Movements of the Sun, Earth, and Moon; Prof. H. M. Lefroy, Insect Enemies of our Food Supplies and How Silk is Grown and Made; Prof. C. H. Lees, Fire Cracks and the Forces Producing Them; Prof. A. Findlay, Colloidal Matter and its Properties; and Sir J. J. Thomson, Spectrum Analysis and its Application to Atomic Structure. The Friday discourses will begin on January 17, when Sir James Dewar will give a lecture on Liquid Air and the War; and discourses will also be delivered by the following gentlemen:—Lt.-Col. A. Balfour, Prof. H. H. Turner, Prof. J. G. Adami, Prof. C. G. Knott, Mr. A. T. Hare, Prof. J. A. McClelland, Prof. H. C. H. Carpenter, Prof. A. Keith, Prof. W. W. Watts, Sir John H. A. Macdonald, and Sir J. J. Thomson.

INFLUENZA is very decidedly on the wane in England and Wales. The Registrar-General's return for the week ending December 7 shows that for the ninety-six great towns the deaths from the epidemic were 3574, which is less than one-half of the deaths in either of the two weeks ending November 9, when the complaint was at its climax. In the eight weeks ending December 7 there were 41,053 deaths from influenza in the ninety-six great towns. The *Times* of December 7 gave the following from its New York correspondent:—"Deaths among the civilian population of the United States from Spanish influenza and pneumonia since September 15 have totalled approximately 350,000. In military camps the number of deaths has exceeded 20,000." In London the deaths from influenza for the week ending December 7 were 660, which is lower than any week since that ending October 19, and is little more than one-quarter of the deaths in either of the two weeks ending November 9. The age incidence of the deaths is higher than in any previous week of the epidemic, 42 per cent. of the deaths occurring at ages above forty-five. The proportion of deaths in London from pneumonia has been smaller than the deaths from bronchitis throughout the epidemic until the week ending December 7, when the deaths from bronchitis were slightly the greater.

THE death is announced, at thirty-five years of age, of Dr. A. E. Stansfeld. From the *British Medical Journal* we learn that Dr. Stansfeld entered St. John's College, Cambridge, with a major scholarship in 1902, and gained First Class honours in both parts of the Natural Sciences Tripos, graduating B.C. in 1909, and proceeding to the M.D. degree in 1915. At St. Bartholomew's Hospital his career was exceptionally brilliant. He won there an entrance scholarship, the Kirkes scholarship and gold medal, the Burrows prize, the Brackenbury medical scholarship, and the Lawrence scholarship and gold medal. After holding the post of house physician he was appointed casualty physician and assistant demonstrator of pathology in the medical school; and at the date of his death on November 25 he was senior demonstrator of pathology at St. Bartholomew's, and physician to the Metropolitan Hospital. In 1911 Dr. Stansfeld obtained the membership of the Royal College of Physicians, and he was elected to the fellowship this year.

THE KING has been pleased to approve the appointment of the Rev. E. W. Barnes, F.R.S., Master of the Temple, to the Canonry of Westminster, vacant owing to the death of the Right Rev. William Boyd Carpenter, D.D., K.C.V.O. Dr. Barnes went to Cambridge from King Edward's School, Birmingham, as a scholar of Trinity, and graduated in 1896, being bracketed as Second Wrangler. In the following year he was placed in the first division of the First Class in the Mathematical Tripos, part ii., and became first Smith's prizeman in 1898. He was president of the Union in 1897, and in 1898 was elected a fellow of his college, afterwards becoming assistant lecturer (1902), junior dean (1906–8), and tutor (1908–15). He was elected a fellow of the Royal Society in 1909.

WE notice with regret the death on December 9, at Basle, of Mr. F. G. Aflalo, at forty-eight years of age. Mr. Aflalo was well known as a traveller, an angler, and author of numerous popular writings on natural history, especially that of fishes. He travelled widely, among other places visiting every fishing port of note. He was the editor of the "Encyclopædia of Sport" and the "Anglers' Library." In 1893 Mr. Aflalo founded the British Sea Anglers' Society, which is now a flourishing association.

MR. CLIFFORD C. PATERSON is resigning his position in the physics department of the National Physical Laboratory, Teddington, and is joining the General

Electric Co., Ltd., as director of research laboratories as from January 1, 1919. Pending the erection of the necessary laboratory buildings the temporary offices and address of the research laboratories of the General Electric Co., Ltd., will be at the Osram Robertson Lamp Works, Hammersmith, London.

ALL the exhibition galleries of the Natural History Museum, Cromwell Road, S.W., are now open to the public on weekdays as in pre-war times. The hours of opening during December, January, and February are from 10 a.m. to 5 p.m.

DURING the present year the Irish newspapers reported the discovery of the apparition of a black pig in the district of Kiltrustan, Co. Roscommon, which caused much alarm, and was supposed to forebode some serious national disaster. The question has been fully discussed by Miss Eleanor Hall in *Folk-lore* (vol. xxix., part 3, September, 1918). The writer shows that the legend of the appearance of the black pig is as ancient as anything we possess in these islands, and that it is specially connected with the great ditch known as the "Black Pig's Dyke," which can be traced in fragments all across the north of Ireland from Bundoran to Donegal Bay, and probably formed the boundary in ancient times of southern and eastern Ulster. The pig seems to have been a sacred animal in ancient Ireland, possibly the representative of the corn spirit, and the hunt of magical boars or swine is the theme of many tales. It is remarkable that it should recently have been resuscitated in Ireland for purposes of religious or political propaganda.

IN the November issue of *Man* Prof. G. Elliot Smith discusses an exhibit now in the Liverpool Free Public Museums obtained in excavations in Honduras. It represents an alligator or crocodile, from the open mouth of which a human face protrudes. The writer identifies this with various forms of the dragon in India, Japan, and Indonesia, and arrives at the conclusion that "no one who conscientiously studies the mythology of the Old World, and appreciates the fortuitous circumstances which determined the arbitrary forms assumed by many of the beliefs and ideas, can refuse to admit that the confused mosaic of the identical elements of culture in America must have come from the other side of the Pacific, and, for the most part, received the impress of Indian civilisation before the fragments were rearranged and built up again into a new pattern in Mexico and Central America."

IN recent years several discoveries of remains of ancient man in North and South America have been announced, which are critically reviewed by Dr. Ales Hrdlička in Bulletin No. 66 of the Bureau of American Ethnology. The La Brea skeleton, found in California in 1914, is now shown to possess no characteristics representative of any Americans earlier than the Indians. A long and careful review of the "fossil" man of Vero, Florida, leads to the conclusion that the remains are of modern Indian type, and represent intentional burials. Dr. Hrdlička adds the useful warning that "those in whose work credulity and fancy have no part, and who possess sufficient hard-earned experience in these matters, can be convinced of geologically ancient man in America only by facts that will make all conscientious doubt on the subject impossible. As chances of peculiar associations of human bones or human artifacts are infinite, anthropology in this country must expect to be called upon again and again to pass on alluring claims of the antiquity of such objects. But the burden of proof of antiquity of such finds lies, and will always lie, with those who may urge such claims. They must show clear, full, conclusive evidence acceptable to anthropology; and no beliefs, opinions, or convictions, even though advanced by men otherwise deserving, can ever take the place of real and sufficient evidence. Our colleagues in collateral branches of science will be sincerely thanked for every genuine help they can give anthropology, but they should not clog our hands."

AN interesting account is given by Mr. Y. Nishikado (*Ber. d. Ohara Inst. f. landwirtsch. Forsch.*, Bd. i., Heft 2, 1917) of the rice blast fungus (Piricularia), which causes serious damage to rice in Japan as well as in other countries. Various strains of this fungus were isolated from rice, Italian millet, green fox-tail grass, crab grass, *Zingiber mioga* and *Z. officinale*. By infection, cultural experiments, and morphological study it was shown that these strains exhibited a marked degree of specialisation to their host, as well as showing other differences of a morphological and physiological character. The author, therefore, distinguishes four species from one another, viz. (1) *Piricularia oryzae*, Br. and Cav. Emend., on rice; (2) *P. grisea* (Cke), Sacc. Emend., on crab grass; (3) *P. setariae*, sp. nov., on Italian millet and green fox-tail grass; and (4) *P. zingiberi*, sp. nov., on *Zingiber mioga* and *Z. officinale*. All the above species grow readily as saprophytes upon artificial media, such as rice-decoction agar. On media containing carbohydrates the fungal growth becomes deep olive to olivaceous-black, according to the species; but, grown without carbohydrates (such as on bouillon agar), the hyphæ remain white. The physiological relationship of the four species of Piricularia to various culture media, temperature, oxygen, etc., was carefully recorded. Piricularia species were found to exhibit a long vitality (of more than four hundred days) in cultures; moreover, in dry conditions the spores of *P. oryzae* maintain their vitality from the autumn until the next summer (about eight months). Therefore the spores may be a source of early infection.

WE have received the year-book and annual rainfall returns of the Norwegian Meteorological Institute for the year 1917. The mean temperature of the year, taking the country as a whole, was in close agreement with the normal, but there was a rather marked deficiency of warmth north of the Arctic Circle, the mean temperature at Alten (lat. 70° N.) being 1·4° C. under the average. January and July were remarkably warm in all parts, while, on the other hand, April and October to November were unusually cold. An interesting summary of the climatic conditions for 1916 is given for Green Harbour, Spitsbergen, the most northern meteorological station in the world, situated in lat. 78° 2′ N. The mean temperature of the year was −10·1° C. (13·8° F.), with extremes of 10·8° C. (51·5° F.) on July 1 and −45·7° C. (−50·2° F.) on January 6. Only in August did the temperature remain above freezing-point. Precipitation was scanty, and amounted to only 11·36 in. Hourly values of temperature and pressure at Green Harbour are given for the year ended June, 1917, along with the tri-daily readings of the various climatic elements. Full particulars of rainfall and other forms of precipitation during 1917 are given for 475 stations, the daily readings being shown for most stations. Monthly and annual values expressed as a percentage of the average are shown for sixty-four stations, the greatest excess, 45 per cent., occurring at Engset (lat. 62° 14′ N., long. 7° 15′ E.), and the maximum deficiency, 41 per cent., at Lillehammer (lat. 61° 7′ N., long. 10° 28′ E.). The isohyetals are drawn on two large-scale maps, which show clearly the sharp variations in rainfall peculiar to a mountainous country like Norway, the extremes ranging from 3400 mm. to 300 mm. of rain in the year.

THE importance of the refractometer to the technical chemist and physicist is being realised to an ever-increasing extent. The determination of the refractive index of a liquid can be made quickly and accurately by means of such an instrument, thus affording valuable information as to the purity of oils, fats, or drugs, or the concentration of solutions. The investigation of the optical properties of glasses and singly and doubly refracting crystals can be carried out with the same instrument. It is highly satisfactory to learn that British manufacturers are paying considerable attention to the construction of refractometers. We have received from the firm of Messrs. Adam Hilger, Ltd., a well-illustrated booklet describing their Abbe refractometer with water-jacketed prisms for the measurement of refractive indices from 1·3000 to 1·7000. The instruments are standardised, and not only the mechanical, but also the optical, parts are interchangeable. We have also received an account of the improved type of Abbe refractometer designed and made by Messrs. Bellingham and Stanley, Ltd. An interesting comparison is made between the features of this instrument and the corresponding features of the German type, and it is claimed that the increased efficiency results in a saving of time of about 50 per cent. in the determination of refractive indices and dispersions.

PROF. MILES WALKER read an interesting paper to the Institution of Electrical Engineers on December 5 on the supply of single-phase power from three-phase systems. In this country the advantages of three-phase distribution of power are thoroughly appreciated, and many of our large power-stations generate electrical power on this system. At the present time there is a great demand in the Midlands for electric power for smelting furnaces. As these furnaces make an excessive demand on the supply station, the companies insist that the load taken by the furnaces must be a "balanced" load, and that suitable precautions are taken to prevent resonance effects, which have on several occasions caused a breakdown of the system. For reasons which are not fully stated in the paper, Prof. Walker urged the adoption of the single-phase furnace. He described the various methods that could be used to operate this furnace without upsetting the balance of the mains. He gave full particulars of the design of a "rotating balancing transformer" for this purpose. The tests made on this machine show that its efficiency was more than 90 per cent. This is a very satisfactory achievement. We are not convinced, however, that it is best to use a single-phase furnace when the supply is three-phase. We know several excellent types of three-phase furnace, and it is possible to connect them with the three-phase transformer, so that the power factor on the primary windings is nearly unity. But even if a single-phase electric furnace was essential, why not use a choking coil, a transformer, and a rotary condenser separately? There is no need to combine them into a single machine.

AN interesting paper on the air supply to boiler-rooms was read by Mr. Richard W. Allen at the Institution of Engineers and Shipbuilders in Scotland on October 22. The paper deals with the closed-stokehold system, and a large part of it is taken up with the losses in the ducts and fan chambers, due to unscientific design. Records are given of experiments conducted on new types of deck intakes, weather flaps, gratings, etc., designed in such a manner as to secure stream-line flow in the currents of air, and the results of experiments carried out on older patterns of the same appliances are also included. For example, a grating having bars of rectangular section produced a drop in pressure of from 0·065 in. to 0·22 in. of water, whilst another having "stream-line" bars showed no perceptible drop in pressure. The delivery through these gratings with the fan running at the same speed was respectively 29,000 and 31,500 cubic ft. of air per minute. The paper constitutes a valuable illustration of the applications of science to engineering design, and as such is to be commended to any engaged in the design and installation of fans.

THE salvage of the *St. Paul* forms the subject of an interesting article in the *Engineer* for December 6. It may be remembered that this ship heeled and sank in New York harbour in April of the present year. The hull settled upon the river-bed with the decks nearly vertical, and penetrated through the bed of silt into the underlying hard soil. This rendered the matter of the removal of guns, etc., a process of considerable difficulty for the divers. Excavational work was done by means of jets of compressed air, thus blowing away the mud which had accumulated round the guns. The ooze also entered the ship through numerous open ports, and hampered the work greatly. The dead-weight of the ship is about 13,000 tons, and the ship had to be rolled forcibly back towards the normal upright position without damage. This was accomplished by use of surface pontoons, of **A**-frames attached to the uppermost side of the ship, and of pumps which cleared the water partially out of the ship. Four pontoons were used which exerted, on the rising tide, a lift of 1200 tons, and produced a righting moment on the ship. The rolling operation took about seven days to accomplish. The final operation comprised the pumping out of the entire vessel. It is of interest to note that the engineers responsible adapted the oxy-acetylene torch for under-water service, and employed it for cutting drainage openings in various parts of the ship. The entire salvage operation has been accomplished with conspicuous success.

THE poisonous character of some cargoes of Burma beans having been noticed, it was suggested that the Burma Department of Agriculture should encourage the cultivation of varieties containing less hydrogen cyanide than does *Phaseolus lunatus*. It has been found, however, that imported Madagascar beans were not suited agriculturally to replace Pe-gya and Pe-byu-gale, and that the prussic acid content increased during two years' cultivation. As bearing on the same problem, the agricultural chemist of the Government of Burma has studied the hydrogen cyanide content of the commonest Burma bean, Pe-gya. The results obtained are described in Bulletin No. 79 of the Agricultural Research Institute, Pusa, by Messrs. F. J. Warth and Ko Ko Gyi. It was found that the method of estimating hydrogen cyanide by distillation (after hydrolysis of the glucoside with acid) into sodium hydrogen carbonate solution and titration with iodine solution could not be used owing to the presence of a substance which gives a slight iodine reaction. The prussic acid was therefore estimated by conversion into Prussian blue, which was ignited and weighed as ferric oxide. Details of the method are given in the bulletin. From about one hundred single-plant samples collected in the cultivators' fields of the Sagaing district ten samples of seed were selected, including two of the highest hydrogen cyanide content, two of the lowest, and four intermediate. These were grown in Hmawbi (high rainfall), Tatkon (intermediate rainfall), and Mandalay (low rainfall). From the results of the analyses of the seeds obtained the following conclusions are drawn:—(1) That the hydrogen cyanide content is an inherent character of pure single-plant cultures; (2) the content varies considerably with the soil and climatic conditions; (3) that cultures giving low amounts of hydrogen cyanide in one locality give low figures under all the conditions tested; (4) that differences in the colour of seeds from a single culture are not correlated with the different hydrogen cyanide content of their progeny; and (5) that the best cultures hitherto found contain prussic acid, but only half that present in the originally imported Madagascar bean.

MESSRS. STANDLEY BELCHER AND MASON, LTD., Church Street, Birmingham, writing with reference to the article on scientific glassware contributed by Dr. M. W. Travers to NATURE of December 5, state that "already by November, 1914, we were supplying beakers, etc., made in our own moulds, from a formula supplied by us." In Dr. Travers's article those firms only were mentioned which mark their glass with the name of the maker and the words "British made," and that accounts for the omission of the names of other firms. No injustice was intended, but it must be admitted that, by displaying and selling glassware which does not bear the maker's name, certain dealers fail in their obligations to British industry and belong to a different category from firms concerned solely with ware distinctly shown to be of British manufacture.

OUR ASTRONOMICAL COLUMN.

FIREBALL ON DECEMBER 6.—At 9h. 36m. a very fine meteor was observed at Bristol, Weston-super-Mare, and Falmouth. The object lit up the partially clouded sky like a vivid flash of lightning. From the descriptions already to hand it appears that the meteor moved slowly from a radiant at 133°+69°, and fell from a height of 67 to 24 miles along a path of 67 miles. The position was from above Rhayader to south-east of Carmarthen, in South Wales, but further observations are necessary for the determination of very trustworthy results.

COMET 1918*d* (SCHORR).—A new comet, of feeble luminosity, was discovered at Bergedorff (Hamburg) by Dr. Schorr on November 23. From observations made on November 23, 24, and 25, Messrs. J. Braae and J. Fischer-Petersen have calculated the following orbital elements:—

$$T = 1918 \text{ August } 7{\cdot}906 \text{ G.M.T.}$$

$$\left.\begin{aligned}\omega &= 230^\circ\ 42{\cdot}18' \\ \Omega &= 129^\circ\ 16{\cdot}90' \\ i &= 5^\circ\ 27{\cdot}21'\end{aligned}\right\} 1918{\cdot}0$$

$$\log q = 0{\cdot}19222$$

The following is an extract from the ephemeris:—

1918	R.A. 1918·0 h. m. s.	Decl. 1918·0 ° ′	Log *r*	Log Δ
Dec. 21	3 58 15	+12 54·3	0·3749	0·1666
25	3 57 41	+13 10·3	0·3816	0·1844
29	3 57 30	+13 27·1	0·3883	0·2024

During December the computed brightness ranges from the 14th to the 15th magnitude.

SPECTRA OF BINARY STARS.—In a communication to the American Astronomical Society (*Pop. Ast.*, vol. xxvi., p. 635) Dr. R. G. Aitken summarises the results of a comparison of his list of close double-stars with the unpublished new Draper Catalogue of stellar spectra. The spectral classes of 3919 pairs, including practically all those as bright as 8·5 B.D. magnitude, were identified, with the results shown in the following table, which also includes the 605 spectroscopic binaries (in the entire sky) which were known in October, 1917:—

Spectral Class	Visual Binaries Numbers	Visual Binaries Percentages		Spectroscopic Binaries Numbers	Spectroscopic Binaries Percentages
0–B8	157	4	...	198	33
B9–A3	1251	32	...	161	26
A5–F2	532	14	...	61	10
F5–G0	1093	28	...	71	12
G5–K2	837	21	...	95	16
K5–Md	49	1	...	19	3
Totals	3919	100	...	605	100

The figures show that while spectroscopic binaries are most numerous among stars of class B, the visual binaries are relatively most numerous among stars of class G.

A NEW "SOLAR CONSTANT" OBSERVATORY.—The Smithsonian Institution has established an observing station at Calama, Chile, for further investigations of the apparent variations of the solar radiation, to which so much attention has been given by the director, Dr. C. G. Abbot (*Pop. Ast.*, vol. xxvi., p. 633). The site is 2250 metres above sea-level, and, according to several years' records, is the most cloudless station in the world. For the two years 1913–14 the average number of wholly cloudless days at 7 a.m. was 228, at 2 p.m. 206, at 9 p.m. 299, and of completely cloudy days none. The precipitation is zero, and the temperature seldom falls below 0° C. or rises above 25° C. The observational conditions would thus appear to be extremely favourable for the work contemplated.

MEDICAL RESEARCH.

MUCH has been said of late as to the importance of encouraging research work in the applied sciences. In the fourth annual report of the Medical Research Committee[1] we have ample illustration of the enormous field presented for research work in medical science under conditions both of peace and of war. The diversion of scientific research to war purposes has nowhere led to more marked service than in the sphere of medical research. When considered from the point of view of mere economy of expenditure, and quite apart from the enormous saving of life and suffering, medical research is shown to pay; thus, by improved methods in the treatment of heart cases at the Colchester Hospital, cures were effected more rapidly, with a consequent saving of 50,000*l*. in a single year.

Although attention has naturally been focussed on the magnitude of pain and on the toll of life involved in war casualties, it must not be forgotten that in times of peace the volume of avoidable suffering and loss is measurable in terms of similar magnitude to those which obtain in war. Among the grave problems with which we are now faced is that of the low standard of our national physique, the statistics of which have recently been described by the Prime Minister as "staggering." The investigations carried out under the auspices of the Medical Research Committee on problems connected with tuberculosis, rickets, growth factors, industrial diseases, industrial fatigue, etc., are a step towards the scientific establishment of a healthy race, and have already reached important results.

A remarkable feature of medical research since the

[1] Fourth Annual Report of the Medical Research Committee, 1917–18 (London: H.M. Stationery Office, 1918.) Price 4*d*. net.

commencement of the war, and especially during the present year, has been the increasing prominence of the work of physiologists; thus the problems of war by poison gas, of aviation, and of surgical shock call for solution on the lines of experimental physiology. It has often been said in the past that British physiologists, though second to none, have not established and maintained sufficiently close contact with clinicians, and this statement, like its converse, is incontestably correct. In this connection, however, fine distinctions cannot be made between academic and practically applied science; it is for the academic worker to discover, and for the practical worker to apply. This is strikingly shown by the application of the researches of Prof. Bayliss on colloids to the treatment of surgical shock, which takes the practical form of the injection of gum solutions to restore the deficient circulation underlying shock. Practical surgery has thus profited in an unexpected way from the results of purely academic labours.

Conversely, in the investigation of the restricted breathing and distress following exposure to poisonous gases, Mr. Barcroft and Dr. Haldane have not only been able to suggest valuable lines of treatment, but have also revealed important new facts in the physiology of respiration.

The work reported in the present publication is divided into three sections, viz. the work of the Central Research Institute, the researches framed before the war, and the work in connection with the war. These researches are, to a great extent, interdependent. It is impossible to give here even a brief summary of the important work which has been carried out, or of the valuable results which have followed from such work carried out, under the auspices of the Medical Research Committee. The present report is itself such a brief summary of work done or projected, and in it reference is made to more than 150 published papers and reports on these various subjects. It is to this annual report and to the publications therein mentioned that the reader should refer for detailed accounts.

Among the subjects of investigation which have yielded important results are those connected with problems of national physique mentioned above, with diseases of the heart and nervous system, and with the study of diabetes. These are researches commenced or framed before the commencement of the war. In connection with the war the information which has been elicited is often of a confidential nature, but much of it has already been made current. Valuable service has been rendered by the Committee to research workers at home and abroad, both by the provision of special apparatus not procurable through the usual channels of Army supply, and by the dissemination of information. With regard to the latter, the monthly "Medical Supplement," containing abstracts of foreign (including enemy) scientific medical work, which have been supplied by the Committee for publication by the War Office General Staff, has been much appreciated.

The most important investigations carried out in connection with the war are those dealing with the medical history of the war, the treatment of infected wounds, of gangrene, dysentery, typhoid, cerebro-spinal fever, trench nephritis, soldiers' heart, chest wounds, surgical shock, "gassed" cases, brain injuries, T.N.T. poisoning, etc. Special mention should also be made of investigations of medical problems connected with flying, and with the testing of aviators as to suitability for flight. Investigations connected with the manufacture and administration of salvarsan are also in progress. Researches into the epidemiology of phthisis, measles, whooping-cough, plague, and influenza are also occupying the attention of various workers under the Committee.

THE BRITISH GLASSWARE INDUSTRY.

THE British Chemical Ware Manufacturers' Association, the British Flint Glass Manufacturers' Association, the British Lamp-blown Scientific Glassware Manufacturers' Association, and the British Laboratory Ware Association—organisations representing the manufacture and distribution of scientific glassware—have jointly addressed the Inter-Departmental Glass Trades Committee, representing the Board of Trade and the Department of Optical Munitions and Glassware Supply (Ministry of Munitions), setting forth their views as to the steps which should be taken to secure the permanent establishment of the trade in this country. They point out that in 1914 the shortage of scientific glassware threatened disaster. Industries such as agriculture, food production of all kinds, and the manufacture of armaments, iron and steel, non-ferrous metals, gas, dyes, explosives, leather, and oil, also our military and civil medical services and the public services responsible for public health and hygiene, which could not be conducted without efficient scientific control, were in danger. The "master key" to the maintenance of our position, and to ultimate victory, was for the moment in the hands of our enemies.

During the war the energy and enterprise of our manufacturers have enabled them to build up the industry and to supply all the requirements of the country, but having always before them the immediate needs of the country rather than the future of the industry, the position in which they now find themselves is highly unfavourable compared with that of manufacturers in enemy and neutral countries. Since the outbreak of the war the cost of materials has risen threefold and wages have doubled. The cost of experimental work, the payment of excess profits duty, and the heavy charges on capital account have made it impossible to accumulate the funds necessary for the proper financing of the industry; and even so far as money has been available, there has been great difficulty in procuring material for the construction of buildings and furnaces suitable in quantity and quality. The labour difficulty and the calling up of all lads of eighteen years of age have seriously hampered the industry.

In view of the importance of the industry, the associations petition the Government to prohibit the importation of scientific glassware into the country, subject not only to licences being granted in the case of articles not manufactured in the country, but also to the control of prices, and later to impose a duty upon imported goods. They also direct attention to the need for financial assistance, and for aid in carrying out those scientific and technical investigations which are essential if the industry is to be established permanently in the country.

THE ANTARCTIC ICE-CAP AND ITS BORDERS.[1]

THOUGH much of the foundation of the Antarctic ice-cap is certainly elevated land, it is quite possible that elsewhere the dome rests upon a floor actually below sea-level. In any case, it is most probable that the smooth ice-surface masks a very irregular rock-basement. The thickness of the ice may, therefore, be expected to be extremely variable, no doubt reaching a maximum of several thousand feet.

An ice-formation of such magnitude introduces questions relating to the flow of its substance and

[1] Introduction of a discussion at the Geological Society on November 6, by Sir Douglas Mawson.

the abrasion of its foundations which do not enter into the physics of ice-masses of smaller dimensions. Here the static pressure on the lower zones of the ice may reach 1 ton per sq. in. At the same time, the temperature may be so increased by ground heat as to be much higher than that prevailing above. As a consequence, when the ice-formation is very thick a more plastic base must be admitted.

The outflow of the inland ice is principally deflected at the coastal margin into depressed areas outlining the heads of gulfs and bays. In such localities the rate of movement and the volume of ice entering the sea are both great—so great, indeed, that extensive floating "glacier tongues" are a feature of such situations, often extending forty to fifty miles from the shore.

Along other stretches of the coast less well placed for receiving contributions from the interior of the continent the outflow is so much less that the destructive influences at work on reaching the sea easily maintain its boundaries at approximately the true coast-line.

As exceptions to this latter prevailing condition, however, there are known already two notable localities where the general overflow from the land maintains itself as an immensely thick floating structure extending far out over the sea—a veritable oceanic ice-cap. To this type of formation we apply Prof. Nordenskjöld's term "shelf-ice." The formations referred to are the Great Ross Barrier at the head of the Ross Sea, and the Shackleton Shelf off the coast of Queen Mary Land.

The former occupies what is really the head of the Ross Sea—a somewhat triangular area. From apex to base it measures five hundred miles, with a base-length of about four hundred miles. This great raft of ice presses forward to the open sea at the rate of a few hundred yards per annum. The available figures, quoted by David and Priestly, show that, at the present rate of advance, the ice now appearing at the sea-face must have left the inner extremity of the floating sheet at some time during the seventh century. A survey of the ice-cliff forming the sea-face indicates by its changing height that the Ross Barrier is of varying thickness. This has been explained by the presence, in localities where it is thickest, of the remnants of the massive-ice contribution received during its course from certain of the large tributary glaciers. The ice from these glaciers, in fact, constitutes a strong framework which stiffens and contains the more crumbling structure derived from the consolidation of the annual snowfall.

To a great extent this must certainly be so; but the influence of a varying snowfall, and the effect of violent periodic winds—a feature of the region—in sweeping the loose snow from certain areas and depositing it in other favoured localities, must be reckoned with. The snowfall is lighter on the eastern side than on the west. Furthermore, the snow tends to accumulate on the western side owing to the fact that the winds regularly blow from the quarter south to east, and not from the west.

In the case of the Shackleton Shelf, this is the more remarkable because it maintains itself as a pontoon stretching into the open sea, even across the drift of the prevailing ocean current.

The deluge of ice, after descending to the sea, presses northwards as an integral whole, at first touching bottom at intervals, then forcing its way past several islands, and eventually reaching an extreme distance of 180 miles from the land before it is mastered by the swell and currents of the Southern Ocean. It is somewhat triangular in form, with the apex out to sea. The base against the land, though not completely charted, extends in all probability for a distance of about two hundred miles.

The main body of the shelf-ice advances rather slowly, but the Denman Glacier, which contributes to it, has a much more rapid movement, very well illustrated by the fact of its ploughing through the other shelf-ice with such force that a shatter-zone some miles wide is developed.

The wall of the shelf-ice on the west side offers an excellent example for study, as it is a section from the point of its departure from the land to its crumbling apex. In the case of the Ross Barrier, the cliff-face is a section across the direction of movement.

At the land end the Shackleton Shelf, from the surface down, is hard glacier-ice breaking with a characteristic fracture. A few miles farther out, away from the influence of the winds descending from the land slopes, a *névé* mantle commences to make its appearance over the original ice formation. As one steams along the face away from the land this capping is observed to increase steadily in thickness. The overburden of *névé* is arranged in regular bands, each of which corresponds with a single year's addition. This being so, it is possible to make some sort of estimate of the age of the formation.

The weight of these additions depresses the top of the original ice below the surface of the water. Though there is a regular annual addition above, it must not be imagined that the total thickness of the pontoon is correspondingly increased; for the solution of the lower surface by the sea has also to be reckoned with. Very often, however, in the *névé* sections of glacier-tongues the cliff-face above the water is observed to stand higher than in the wholly ice zone at the land end. This is to be expected on account of the lighter nature of the *névé* ice added, there being a larger proportion of air sealed up in it.

The observed height above sea-level of Antarctic shelf-ice so far recorded ranges from about 20 ft. to more than 200 ft. A common figure is from 90 ft. to 120 ft., suggesting a total thickness of 600 ft. to 1000 ft.

Although the height of the cliff-face presented by shelf-ice gives some idea of its total thickness, a really accurate method of determination is badly needed. The Australasian Expedition hit upon a method which gives positive results, in some cases at least. This consists in taking serial temperatures of the sea-water in depth near the face of the shelf-ice. As there is always a current flowing beneath the ice, the bottom of it is likely to be marked by a sudden slight change in the water temperature, easily observed when the observations are plotted as a graph.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The titular degree of M.A., *honoris causa*, has been conferred upon Mr. Frederic William Harmer, of Norwich, in recognition of his researches in geology, especially the geology of the Eastern Counties. Mr. Harmer is the father of Dr. S. F. Harmer, Keeper of the Department of Zoology, British Museum (Natural History).

LONDON.—At University College arrangements have now been completed in the faculty of engineering to enable students whose courses have been interrupted by war service, or those who were unable to begin their engineering studies last October owing to war conditions, to resume or begin their studies by entering next term, January 13, 1919. For both classes of students additional work will be provided during parts of the Easter and Long Vacations, so as to enable them to get in a full session's work between January and August, 1919. Arrangements of a like kind are in contemplation in other faculties.

OXFORD.—On December 3 the honorary degree of D.Sc. was conferred on Mr. William Crooke. In presenting Mr. Crooke, the Public Orator referred to his admirable work as a member of the Indian Civil Service, and especially to his continuation of the research on the anthropology of the native races of India so ably begun by the late Sir Herbert Risley, whose chief work Mr. Crooke had lately edited. The recipient of the degree, it was added, was recognised as a leading authority on the important subject of caste and tribal groups in India generally, and particularly in the N.W. Provinces and Oudh.

Magdalen College has long been honourably noted for the support that it has given to natural science in the University. Two recent elections by the president and fellows of that society have worthily carried on the tradition. Mr. E. S. Craig, of University College, Assistant Registrar of the University, has for many years been well known as a successful teacher of mathematics and physics, especially in the electrical department, where he acted for some time as demonstrator under Prof. Townsend. His election to a fellowship at Magdalen is widely welcomed in the University as a well-merited recognition of excellent scientific work, as well as of capable and courteous administration. Mr. E. G. T. Liddell, of Trinity College, has been elected to a senior demyship in the same college. Mr. Liddell, who was recently placed in the First Class in the final honour school (physiology), has been engaged in research work at the Lister Institute of Preventive Medicine.

THE annual meeting of the Association of Public School Science Masters will be held at the London Day Training College, Southampton Row, on December 31, 1918, and January 1, 1919, under the presidency of Sir Ronald Ross. The subject of the president's address will be "Observations on the Results of our System of Education." A lecture on poison-gas warfare will be given by Lt.-Col. Smithells. There will be discussions on the importance of restricting specialisation in university scholarship examinations and giving weight to general education, opened by Mr. F. S. Young; science in the general education of boys, opened by Mr. W. D. Eggar and Mr. C. V. G. Civil; and courses in general science for classical Sixth Forms, opened by the Rev. S. A. McDowall.

THE annual meeting of the Geographical Association will be held on Friday, January 3, and Saturday, January 4. In the afternoon of the former day Mr. A. R. Hinks will give an address on war-maps at the Royal Geographical Society's house, Kensington Gore, S.W.7. A collection of captured maps and maps made by the R.G.S. will be on view; and there will also be an exhibition of war maps, kindly lent by the authorities, at the London Day Training College, where the remaining meetings will be held. An address will be given by the president, Prof. Grenville A. J. Cole, on the narrow seas and the Arctic route to Muscovy; and other subjects to be brought forward are:—The historical geography of West Africa, by Mr. W. H. Barker, and when and how often should we teach the geography of the British Isles to our pupils, a discussion led by Miss D. D. Adam and Mr. C. B. Fawcett.

DETAILS of the bequests under the will of Mrs. Russell Sage, whose death was announced on November 4, are contained in the issue of *Science* for November 22. Mrs. Sage was the widow of Mr. Russell Sage, who died in 1906, bequeathing a fortune of about fifteen millions sterling almost entirely to her. Her will disposes of an estate estimated at 10,000,000*l.*, of which more than 8,000,000*l.* is to be distributed among charitable, educational, and religious institutions. It is said that since the death of her husband Mrs. Sage had given between seven and eight millions sterling to various institutions and charities, using part of the principal, as well as the income, of the Sage estate in these benefactions. Certain sums given by Mrs. Sage in her lifetime to institutions are to be deducted from the bequests under the will. Among the benefactions under the will may be mentioned:—Russell Sage Foundation, 1,120,000*l.*; Metropolitan Museum of Art and the American Museum of Natural History, 160,000*l.* each; the New York Botanical Garden, New York Zoological Society, Troy Polytechnic Institute, and Union College, Shenectady, 160,000*l.* each; Syracuse University, 320,000*l.*; and 160,000*l.* each to thirteen other colleges and universities in the United States. Smaller bequests are made to six other educational institutions.

AT the annual prize distribution on December 7 of the Northampton Polytechnic Institute, St. John Street, London, E.C.1, the principal, Dr. R. Mullineux Walmsley, read a full report of the many activities of the institution during the session 1917–18. In the Engineering Day College the manufacture of high-class munitions upon a commercial scale, commenced on July 1, 1915, was continued uninterruptedly during the whole session. During its existence this workshop has produced 14,720 high precision gauges, many of them accurate to two ten-thousandths of an inch, and 43,511 gun parts for Woolwich Arsenal—a record which is believed to be in excess of the record of any similar educational workshop in the metropolis. In the Technical Optics Department the work of training women students in full-time classes in lens and prism grinding was vigorously prosecuted throughout the whole year. This work was pressed forward, with the result that an almost continuous stream of women workers in the industry was available for the development and extension of existing optical workshops, not only in England, but also in Scotland and Ireland. The training of disabled sailors and soldiers to take their place in the life of the country was continued. During the session nine complete courses for training suitable men as electrical sub-station attendants were held, and the whole of the men trained were placed out. This brought the total number of such courses held since they were started in June, 1916, to twenty. The number of individual students who joined the Colours during the war was 2052, including twenty-five members of the staff; of these 237 obtained commissions, 90 gave their lives in the service of their country, and 190 names occur on the Roll of Distinction.

AN announcement has been published by the Department of Demobilisation and Resettlement of the Ministry of Labour in connection with the higher education and training for men who have served in the Forces. In order to restore the supply of men of higher scientific, professional, and business attainments whom the nation needs for every profession and industry, the Government has decided in suitable cases to provide financial assistance for ex-Service men who desire to resume suitable education and training, with a view to their resettlement in civil life, but who cannot otherwise afford to meet the expenses involved. The scheme sanctioned applies equally to officers, warrant officers, non-commissioned officers, and men in the ranks, provided they are of suitable educational promise. The amount of the assistance to be granted will be limited to the actual sum deemed sufficient to meet the necessary fees and the expenses of maintenance of the candidate, after due account has been taken of his private means, if any. It is intended, however, that the amount of the assistance shall be such as will enable a candidate to take his course of training under reasonably adequate conditions. The types of training for which assistance may be granted are:—(1) Courses of higher education in institutions approved by the Board of Education or by the Board of Agriculture and Fisheries, or by the corresponding Departments for Scotland or Ireland; (2) such practical training in offices and works and professional employments as may be approved by the Ministry of Labour; and (3) such practical training on farms, etc., as may be approved by the Board of Agriculture and Fisheries, or by the corresponding Department for Scotland or Ireland. The Ministry of Pensions will co-operate in the working of the scheme on behalf of disabled officers and men, who will be eligible for assistance under the scheme, subject to compliance with the prescribed conditions. The existing provisions of the Royal Warrants as to training the disabled will remain in force, so far as they may be more beneficial to candidates than the provision made by this scheme.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 5.—Dr. J. W. L. Glaisher, vice-president, in the chair.—Dr. C. **Chree**: Electric potential gradient and atmospheric opacity at Kew Observatory. It has been the practice for many years at Kew Observatory at the ordinary hours of meteorological observation to record the most distant of a selected series of objects which is visible at the time. Separate notes are also made of the presence of mist or fog. Thus a large amount of information has accumulated as to the greater or less opacity of the atmosphere. The present paper utilises the data for a comparison of atmospheric opacity and the potential gradient of atmospheric electricity. It is found that even for the smallest amount of opacity which the observation scheme is able to disclose, the value of the potential gradient increases with the opacity. The effect of mist or fog on the potential gradients recorded in winter is great, and, there being a large diurnal variation in the incidence of mist or fog, there is consequently a noteworthy influence on the character of the diurnal variation of potential gradient.—E. **Nevill**: The value of the secular acceleration of the mean longitude of the moon. It is shown that where the observed errors of the tabular place of the moon are properly corrected for the observed errors in the values of the principal coefficients employed in Hansen's Lunar Tables, the residual errors are such as to show that the true value of the coefficient of the secular acceleration in the mean motion of the moon cannot differ sensibly from the value 6·2″ assigned to it by theory, so that it affords no evidence from observation of any tidal retardation in the rotation of the earth.—S. B. **Schryver** and Nita E. **Speer**: Investigations dealing with the state of aggregation. Part iv.: The flocculation of colloids by salts containing univalent organic ions. The theories dealing with the mechanism of the action of salts in flocculating colloids is discussed. According to one theory the adsorption of the discharging ion of the flocculating salt is the predominant action. If this is the case, it might be expected that salts which cause the greatest lowering of the surface tension of water would exert the greatest flocculating action where water is the dispersion medium. A series of salts containing organic ions was chosen, of which the normal solutions exhibit a wide range of surface tensions, and their flocculating action on a number of colloids was investigated. In general, no relationship was found to exist between this action and the surface tensions of the solutions. In one case, however (that of mastic), there was a marked parallelism. Attention is directed to the fact that two classes of suspensoid colloids might exist. The first class comprises those colloids which owe their charge to an ion of the salt from which the colloid is prepared, as, for example, the chlorine ion attached to a ferric hydroxide sol prepared by the hydrolysis of ferric chloride. The second class includes colloids in which the charge is due to a dissociated labile ion belonging to the colloid proper, held electrostatically to a less labile ion, as, for example, the mastic colloid, when a hydrogen ion (of the carboxyl radicle) is held electrostatically to a large anion. It is proposed to designate colloids of the first class *exionic*, and those of the second class *endionic*.—E. **Hatschek**: A study of the forms assumed by drops and vortices of a gelatinising liquid in various coagulating solutions. The paper describes a series of experiments in which drops of gelatin sol are allowed to fall into various solutions. Conditions can be so arranged that gelation takes place when any desired shape of the hanging drop or vortex thus produced has been attained. The result is permanent models of what are only transient forms when two liquids are employed, as in the experimental methods practised hitherto. If the solutions have a dehydrating effect on gelatin, a number of features not produced at all with liquids appear, such as radial ribs and membranes, or, generally speaking, cross-sections other than circular. The conditions can further be varied by the use of solutions, or of salts added to the gelatin sol, which leads to the production of permeable or semi-permeable membranes on the gelatin drop. By these means a further range of forms can be obtained, such as bi-concave discs of the shape of the human red blood corpuscle, hanging drops showing abnormal profiles and superficial segmentation, and vortex forms greatly modified by general shrinkage. Many of the forms obtained in these experiments show a close resemblance to those of the simpler organisms, both as regards general outline and secondary features.

Geological Society, December 4.—Mr. G. W. Lamplugh, president, in the chair.—Lt.-Col. Wheelton **Hind** and Dr. A. **Wilmore**: The Carboniferous succession of the Clitheroe province. The tectonic structure of the province consists of three dissected parallel anticlinal folds in beds of Carboniferous Limestone, Pendleside, and Millstone Grit age. Dissection has exposed the lower beds of Z, C, and S age, as the tectonic axes and beds of D, P, and Millstone Grit age occur on the flanks. The authors give the following table of Goniatite zones:—

	"Middle" Coal Measures	*Gastrioceras carbonarium*, von Buch
	Lower Coal Measures	*Gastrioceras carbonarium*, von Buch
	Upper Millstone Grit	*Gastrioceras listeri*, Martin
	Sabden Shales	*Glyphioceras diadema*, Beyrich
Zones of the Pendleside Series	Shales below Millstone Grit	
	Bowland Shales	*Glyphioceras bilingue*, Salter; *Glyphioceras reticulatum*, Phillips; *Glyphioceras spirale*, Phillips
		Glyphioceras striatum, Phillips
	Posidonomya becheri Shales	*Nomismoceras rotiforme*, Phillips; *Prolecanites compressus*, Sowerby
	Carboniferous Limestone, D_2	*Glyphioceras crenistria*, Phillips

Linnean Society, December 5.—Sir David Prain, president, in the chair.—Prof. W. A. **Haswell**: The Exogoneæ. The author gives a detailed account of the species occurring at Port Jackson of this group of small Polychæte worms, belonging to the family

Syllidæ. After discussing the histology of the muscular gizzard, the author describes the reproductive organs, the modification of the nephridia at maturity, and the fixation of the ova on the ventral or dorsal surface of the mother, where they undergo development. One species, *Grubea pusilloides*, is described as hermaphrodite. The paper closes with an account of the early cleavage of the ovum and the later development.—C. D. **Soar**: Coloured drawings of British mites. The drawings illustrate the whole of the Hydracarina found and recorded for the British area. In all, there are 246 species, representing forty-two distinct genera. More than forty species and four genera were figured and described for the first time as British, and of these only four or five have since been recorded on the Continent.

Mathematical Society, December 12.—Mr. J. E. Campbell, president, in the chair.—G. H. **Hardy** and J. E. **Littlewood**: Applications of the method of Farey dissection in the analytic theory of numbers:—(1) A new solution of Waring's problem. (2) Proof that every large number is the sum of at most thirty-three biquadrates. (3) The Riemann hypothesis and the expression of a number as the sum of a stated number of primes.—N. M. **Shah** and B. M. **Wilson**: Numerical data connected with Goldbach's theorem.—Prof. M. **Fréchet**: Integrals in abstract fields.

MANCHESTER.

Literary and Philosophical Society, November 26.—Mr. W. Thomson, president, in the chair.—Prof. H. **Lamb**: The movements of the eye. The theory of the movements of the eye, as developed by Helmholtz, includes some results of great interest to mathematicians as well as to physiologists. Unfortunately, they have scarcely become familiar to mathematicians, who have been apt to regard the whole matter as outside their province. The analytical investigations of Helmholtz are, moreover, long and intricate, and have doubtless been an obstacle to mathematicians and physiologists alike. The author had found that with the help of one or two propositions in the theory of rotation, now well known, the whole question can be treated in a simple and purely geometrical manner, without the use of a single mathematical symbol. The paper consisted of an exposition of the subject from the above point of view. By the aid of diagrams the classical theorems of Euler and Sir W. Hamilton on rotation were explained and used to illustrate Listing's law, which governs the positions of the eyeball when the gaze is directed to various parts of the field. Finally, the apparent distortion of straight lines and the theory of those lines which are *apparently* straight were considered. The eye is necessarily imperfect in these respects, and in obeying Listing's law effects a compromise, which is probably the best admissible.

DUBLIN.

Royal Irish Academy, November 30.—H. **Ryan** and P. **Ryan**: The action of nitric acid and nitrous acid on diphenylamine. The action of the oxy-acids of nitrogen on diphenylamine in carbon tetrachloride solution is similar to that which takes place between the same bodies in acetic acid solution. The products isolated in the various stages of the reaction at the ordinary temperature and at low concentrations of the interacting substances were: Diphenylnitrosoamine, 4-nitrodiphenylamine, 4-nitrodiphenylnitrosoamine, 4 : 10- and 2 : 10-dinitrodiphenylnitrosoamines, 4 : 10-, 2 : 10-, and 2 : 8-dinitrodiphenylamines, 2 : 4 : 8-trinitrodiphenylamine, and 2 : 4 : 8 : 10-tetranitrodiphenylamine.—H. **Ryan** and W. **O'Riordan**: The action of bromine on some derivatives of diphenylamine. Diphenylamine is generally estimated by converting it by means of bromine into its tetrabromo-derivative, and either weighing this or determining the amount of bromine absorbed during the reaction. The assumption that the only product formed from diphenylamine by interaction with a cold solution of bromine is tetrabromodiphenylamine is not entirely justified, inasmuch as hexabromodiphenylamine is also formed. In this connection the action of bromine on some nitro-derivatives of diphenylamine was also examined. Bromine reacted with 4-nitrodiphenylnitrosoamine, forming a dibromo-4-nitrodiphenylamine melting at 216° C., with 2 : 4-dinitrodiphenylamine giving a dibromo-2 : 4-dinitrodiphenylamine melting at 195·5° C., with 2 : 10-dinitrodiphenylamine or 2 : 10-dinitrodiphenylnitrosoamine forming a dibromodinitro-derivative melting at 185° C., and with 4 : 10-dinitrodiphenylamine or 4 : 10-dinitrodiphenylnitrosoamine yielding a dibromo-4 : 10-dinitrodiphenylamine melting at 247° C. At the ordinary temperature bromine did not react on a solution of 2 : 4 : 8 : 10-tetranitrodiphenylamine.

EDINBURGH.

Royal Society, December 2.—Dr. John Horne, president, in the chair.—Prof. J. **Stephenson** and Dr. Baini **Prashad**: The calciferous glands of earthworms. The simplest condition of these calciferous glands is that in which there occur slight segmental bulgings of the œsophageal canal, within which are a number of transverse folds of the epithelium. In many forms these bulgings become diverticula, such, for example, as in *Octochaetus barkudensis*, where the glands are large lobed sacs communicating with the œsophageal canal only by a narrow neck or "duct." The condition in Eutyphœus may be considered as having arisen from the fusion, along their edges, of a series of parallel epithelial lamellæ. In the Lumbricidæ the condition originated in a series of longitudinal lamellæ. The mode of evolution has been similar to what has happened in Eutyphœus, the inner edges of the lamellæ having fused. The epithelium of the glands is in all cases continuous with that of the œsophagus, and comparative anatomy shows that the various forms of glands are essentially due to various forms and degrees of complexity of the epithelial folds. The glands are, therefore, not mesodermal in origin, and are not merely the walls of blood-vessels, as has recently been contended.—Prof. J. **Stephenson** and H. **Ram**: The prostate glands of the earthworms of the family Megascolecidæ. Typical examples of the lobate and tubular prostates of the Megascolecidæ have been studied in detail. In both, the cells of the gland disintegrate to form the secretion, which takes the form of granules; in the functioning gland, therefore, cell outlines are largely lost. Regeneration takes place in both by the formation of discrete cells at the periphery of the gland. In the tubular form all the cells probably reach the lumen of the gland, and discharge directly into it. In the lobate form it appears that a large number of cells never reach the lumen of the intralobular ductule. Evidence of various kinds was supplied in proof of the fact that the glandular mass is in neither case an invagination from the surface, but is derived from tissues of mesoblastic origin.—Dr. A. M. **Williams**: The adsorption isotherm at low concentrations. It was shown that for very small adsorptions the adsorption law, both for gases and solutions, may be expressed in the form $\alpha=\alpha_0 c$, where α is the amount adsorbed and c the equilibrium concentration. The general form of the adsorption curve for solutions was deduced from the above conclusion and found to agree with the results of different observers.—Lieut. J. **Logie**: The origin of anticyclones and depressions. In this paper importance was laid on radiation as the chief cause of the differences between cyclones and anticyclones. Cyclones are caused by the local cooling of the air, and anticyclones by heating, and not the reverse, as commonly believed. These facts were in harmony with the theory presented, which was developed in mathematical form in accordance with the ordinary gas laws. It was found that the entropy of the air would be increased in the region of origin, which, from the data as to upper-air temperatures provided by Mr. W. H. Dines, was estimated as being at a height of four to six kilometres. The effect of differing density of the air under the same pressure gradient was shown to intensify the pressure differences. The radiative effect might be obtained by the movement of air from equator to pole, by changes of diathermancy due to formation of thin haze, or by the covering of a large tract of country by cloud, and these causes were considered adequate in giving the variation of radiative effect required.

MELBOURNE.

Royal Society of Victoria, October 10.—Mr. J. A. Kershaw, president, in the chair.—W. M. **Bale**: Further notes on Australian Hydroids. Part iv. In this paper the author describes several new species from Victorian waters. *Lytocarpus urens*, Kirchenpauer, from Moreton Bay specimens, is proved to be the female form of *L. phillipsinus*, K. Notes are added regarding the specific relationships of the Australian brown Hydras, generally referred to *H. oligactis* (*H. fusca*). It is possible that they belong to other, European and American, species, which further research will determine.

SYDNEY.

Royal Society of New South Wales, October 2.—Mr. W. S. Dun, president, in the chair.—R. H. **Cambage**: Acacia seedlings. Part iv. The author described the seedlings of twelve species, and pointed out that although bipinnate leaves are the dominant form in seedlings of this genus, yet one species, *A. alata*, so far as his tests had gone, did not appear to produce a bipinnate leaf at all, but had simply pinnate leaves and phyllodes. He stated that seeds of *A. melanoxylon* and *A. penninervis* had germinated after having been in sea-water for 469 days, and of *A. farnesiana* after 1375 days.

BOOKS RECEIVED.

Mnemonic Notation for Engineering Formulæ. Report of the Science Committee of the Concrete Institute. With explanatory notes by E. F. Etchells. Pp. 116. (London: E. and F. N. Spon, Ltd.) 6*s.* net.

Life of Frederick Courtenay Selous, D.S.O. By J. E. Millais. Pp. xi+387. (London: Longmans and Co.) 21*s.* net.

The Science and Practice of Manuring. By W. Dyke. Revised and enlarged edition. Pp. iv+157. (London: The Lockwood Press.) 2*s.* net.

British Rainfall, 1917. By Dr. H. R. Mill and C. Salter. Pp. 240. (London: E. Stanford, Ltd.) 10*s.*

Modern Chemistry and Chemical Industry of Starch and Cellulose (with Reference to India). By Prof. T. C. Chaudhuri. Pp. viii+156. (Calcutta and London: Butterworth and Co.) 3.12 rupees net.

Bureau of Education, India. Progress of Education in India, 1912–17. By H. Sharp. Vol. i. Pp. vi+215. (Calcutta: Supt. Govt. Printing, India.) 3.10 rupees, or 5*s.* 6*d.*

The Next Step in Religion. By Dr. R. W. Sellars. Pp. 228. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 1.50 dollars.

Wild Life of the World. By R. Lydekker. 3 vols. Vol. i., pp. xiv+472; vol. ii., pp. xii+440; vol. iii., pp. xi+457. (London: F. Warne and Co.) 4 guineas the three vols.

An Introduction to the Study of Biological Chemistry. By Prof. S. B. Schryver. Pp. 340. (London and Edinburgh: T. C. and E. C. Jack, Ltd.) 6*s.* net.

The Grasses and Grasslands of South Africa. By Prof. J. W. Bews. Pp. vi+161. (Pietermaritzburg: P. Davis and Sons, Ltd.) 7*s.* 6*d.* net.

Tables of Refractive Indices. Vol. i.: Essential Oils. Compiled by R. Kanthack. Edited by Dr. J. N. Goldsmith. Pp. 148. (London: Adam Hilger, Ltd.) 15*s.* net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 19.

CHEMICAL SOCIETY, at 8.—Prof. F. Soddy: The Conception of the Chemical Element as Enlarged by the Study of Radio-active Change.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—P. Hunter-Brown: Carbon Brushes, Considered in Relation to the Design and Operation of Electrical Machinery.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion opened by the President*: Summary of Progress in Photometry, with Special Reference to War Problems.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

No. 2565, Vol. 102] THURSDAY, DECEMBER 26, 1918 [Price Ninepence.

Registered as a Newspaper at the General Post Office.]

THURSDAY, DECEMBER 26, 1918.

MYCOLOGY AND PLANT PATHOLOGY.

A Text-book of Mycology and Plant Pathology. By Prof. J. W. Harshberger. Pp. xiii+779. (London: J. and A. Churchill, 1918.) Price 15*s.* net.

THIS text-book cannot fail to give much valuable information to the rapidly increasing number of students of plant diseases. Part i. deals with mycology in a general sense, comprising classification, morphology, histology, physiology, bio-chemistry, ecology, and phylogeny. In part ii. general plant pathology is dealt with; the predisposing and determining factors of disease and the botanical phenomena accompanying pathologic plant growth are discussed in detail. A very useful chapter, well illustrated and full of practical details, is given on "Practical Tree Surgery." Part iii. is entitled "Special Plant Pathology," and comprises a list of the common diseases of economic plants in the United States and Canada, followed by a detailed account of about 100 parasitic and non-parasitic diseases, which have been selected either because of the economic importance of the disease over wide geographical areas, or because their study helps the student to connect up the practical and the systematic parts of the book. Some very interesting information from various bulletins of the United States agricultural experiment stations is given in this section. It would have been well if the author had made room for a full account of the wart-disease of the potato (*Synchytrium endobioticum*), in view of the fact that it is the most destructive disease of the potato known, and that while the United States are believed to be still free, an alarming outbreak occurred in Canada in 1912. An account of the methods employed against this disease by the agricultural authorities in this country for the past ten years would have formed an excellent object-lesson for the student of the disastrous results that follow from the neglect of scientific measures in dealing with the early outbreaks of a new fungous pest.

Part iv. consists of laboratory exercises in the cultural studies of fungi, and this part will endear the book to the practical working student of mycology, in the same way as Percival's "Agricultural Botany" has been welcomed by the student in agricultural botany. Information is also given on micrometry, microscopic drawing and photomicrography, staining, culture media, and methods of microtoming. The methods of staining the flagellæ of bacteria appear to have been omitted here, no doubt accidentally.

The book concludes with appendixes on methods of making fungicides and insecticides and their formulæ, together with a spray calendar. The new ammonium sulphide wash might have been mentioned, as this is useful where any discoloration of the part of the plant sprayed (*e.g.* fruit) is to be avoided. The other appendixes consist of dichotomous keys to the classification of the Myxogastrales, Mucor, Aspergillus, Penicillium, the Erysiphaceæ, and the Agaricaceæ.

In any future edition it would be well to satisfy the curiosity of the student by giving more information on the subject of Eriksson's "mycoplasm," since it has been advanced to account not only for sudden outbreaks of rusts, but also for the appearance in the spring of the American gooseberry-mildew. From the remark made by Prof. Harshberger on p. 308 it may be inferred that he belongs to the majority who hold that there is no satisfactory evidence of the existence in Nature of "mycoplasm." The treatment of the subject of specialisation of parasitism seems to us to be too meagre. The subject is not only of great interest physiologically, but also of considerable economic importance. It is a loss to find no account given of the thorough investigations carried out by Marshall Ward in the Uredineæ, or of the work of the various mycologists—including G. M. Reed—in the United States on the same problems in the Erysiphaceæ. The work recently published by H. Wormald shows that similar phenomena of specialisation occur in the species of Monilia which cause the "brown rot" diseases. Since Prof. Harshberger says that "to be a successful pathologist one must be a good morphologist, histologist, geneticist, and physiologist," some account should have been given the student of the work of Prof. R. H. Biffen, who first established the inheritance of disease-resistance on Mendelian lines.

The morphological description of the Erysiphaceæ on p. 155 is incorrect, since that family includes one genus with an endophytic mycelium. The common rose-mildew of the United States is not, as stated on p. 461, *Sphaerotheca pannosa*, but *S. humuli*. The danger of generalising as to what is the dominant factor in outbreaks of disease under field conditions is shown by Prof. Harshberger's statement on p. 324 that "early sowing of winter wheat has been found beneficial in the reduction of the amount of stinking smut, for wheat sown early in October showed no sign of infection, while plants sown at the end of October were much attacked (about 60 per cent.) by the smut." In the case of a field of "bunted" wheat which came under the present writer's notice during the past season, the percentage of bunted grains, on an actual count, was found to be considerably higher in that portion of the field which had been sown a few weeks earlier! Since "bunt" and "smut" diseases of cereals appear to be on the increase in this country, we may note here the statement, to which Prof. Harshberger gives credence, that "in the summer of 1914 300 threshing machines were blown up or burned by smut explosions"; the ignition of the oily and dry masses of smut spores is attributed to static electricity in the cylinder of the threshing machine.

It would be difficult to accept—if this were necessary—all the terms used in this book. While we may have to accept "æciospore," "urediniospore," and "teliospore," it does appear unnecessary to replace the convenient word "conidium" by "conidiospore." Also, "epiphytotisms," in the place of "epidemics," is rather dreadful. And a firm protest must be made against the attempt to label the "wart-disease of the potato" "chytridiose," or we shall be required ultimately to tell the farmer to call "potato-blight" "phytophthorose"!

Not the least valuable part of this book, which is indispensable to all mycologists, is the excellent bibliography (dealing chiefly with American and German authors) which is given in all the sections.

E. S. S.

DYNAMICAL AND POPULAR ASTRONOMY.

(1) *An Introductory Treatise on Dynamical Astronomy.* By Prof. H. C. Plummer. Pp. xx + 344. (Cambridge: At the University Press, 1918.) Price 18*s.* net.

(2) *The Destinies of the Stars.* By Prof. Svante Arrhenius. Authorised translation from the Swedish by J. E. Fries. Illustrated. Pp. xviii + 256. (New York and London: G. P. Putnam's Sons, The Knickerbocker Press, 1918.) Price 7*s.* 6*d.* net.

(1) THERE has long been a need for a general book on celestial mechanics on a smaller scale and at a more accessible price than the standard work of Tisserand, and Prof. Plummer's recent publication is a very successful effort to satisfy that need. It is so concisely written that a most remarkable amount of material is made available within a limited space, with only occasional loss of clearness. Halphen's theorem, that if the acceleration of a particle is a function of its position alone, and all the trajectories are plane curves, then the acceleration is always directed towards a fixed point, forms the commencement of the problem of two bodies. This constitutes a most welcome innovation, as Kepler's second law now becomes a consequence of the first, and its truth a confirmation of it. The methods of determining from observation the orbits of planets, comets, and visual and spectroscopic binaries are treated in detail, and then the author passes on to the treatment of perturbations, which is dealt with much as usual; but it is pleasant to see that chap. xvi., on secular perturbations, includes a table of numerical results. Very useful features are the account of recent work on methods of numerical interpolation and integration, and the description of Cowell and Crommelin's method of computing special perturbations. The lunar theory and the theories of precession, nutation, and lunar libration are also discussed in some detail. Misprints are few and the index is good. The present writer would like to suggest, however, that in a future edition tables of the best available values of the elements of the solar system, in astronomical and metrical units, should be included; for these are the fundamental data of dynamical astronomy, and are not usually presented in any convenient form.

(2) Prof. Arrhenius's work is a popular account of three very different astronomical subjects. The first chapter deals with the influence of the heavenly bodies on primitive human thought, describing how the moon's phases came to be used as a basis of chronology, on account of their easily recognisable variability, and how with the advance of culture the importance attributed to the year and the sun increased. The early knowledge of the major planets is also discussed, especially with regard to its religious bearing. The interesting fact that the Mexican priests discovered the very accurate coincidence between five synodic periods of Venus and eight solar years is mentioned incidentally.

The second chapter is devoted to the nature and origin of the Milky Way. Prof. Arrhenius inclines to the view that it is a spiral nebula, and suggests that it may have been formed by the collision of two gaseous nebulæ of immense size. Recent investigations on stellar motions and their relation to spectral type, and on the rotations of nebulæ, are discussed at considerable length. It is highly creditable to the author and the publishers that work published so recently as 1917 is referred to, though the absence of all mention of the ellipsoidal theory is regrettable.

The surface features, and especially the climatic conditions, of the planets are next discussed at great length and in a very interesting manner. The history of the earth's atmosphere, regarded as largely derived originally from volcanic gases, leads to an account of the leakage of gases from planetary atmospheres and the ability of the inner planets to support life. Mars is declared uninhabitable, as its mean temperature must be about -37° C., and even at noon on the equator it can scarcely rise much above freezing-point; the available water supply is also exceedingly low. The canals are considered to be fissures corresponding with the dislocation fissures on the earth.

Mercury and the moon are totally uninhabitable on account of the absence of atmosphere. Venus, on the other hand, has a dense, warm atmosphere of high humidity, and "everything on it is dripping wet." Life may therefore exist; that near the equator would be of a low order on account of the uniform climate and lack of need for specialisation; that in higher latitudes may, however, be more highly differentiated.

A few blemishes somewhat mar a very instructive book. Such are the title, which is unfortunate for a work the scope of which, except for one chapter of forty-three pages, is confined to the solar system; the opening sentence, "Astronomy occupies a rather unique position among the natural sciences"; the illucid account of W. S. Adams's work on p. 50; such remarks as "the original matter of the stars stands still in space" (p. 55); "what force . . . causes the motion of the stars?" (p. 56); "Mercury lies five times nearer the sun than the earth does" (p. 230); the mention of "hydrate of chlorine" (p. 165); and the reference (p. 245) to "the title-page illustration," which does not exist.

H. J.

ELECTRICAL INSTRUMENTS.

Industrial Electrical Measuring Instruments. By Kenelm Edgcumbe. Second edition, revised and enlarged. Pp. xvi+414. (London: Constable and Co., Ltd., 1918.) Price 16s. net.

IN the student days of their career the majority of electrical engineers are strongly attracted towards the design and manufacture of large machines. To design a 10,000-h.p. dynamo is found to be easier and far more exciting than to invent some small improvement in a measuring instrument. This is one of the reasons which make it far more difficult to get—for instance—a manager for a telephone factory than for a large machine shop. The former would probably be offered a salary four times as large as the latter, although the latter probably did much better during his college course. It is advisable, therefore, for students to remember that there are certain drawbacks to following what is for the moment the fashionable branch of engineering to the neglect of much more profitable branches.

Mr. Edgcumbe's wide experience in the manufacturing and testing of instruments admirably qualifies him for his task. Although there have been no great changes introduced in the types of instruments used since the first edition was published, yet the continuous developments that have taken place have made it necessary to rewrite the whole book. Mathematical reasoning is avoided so far as possible. One consequence is that the mathematician who studies the work carefully will be tempted to explore for himself numerous practical and interesting problems. On p. 25, for instance, there is a diagram of a volt-ammeter with an ohm scale. Few mathematicians will be able to resist the temptation of finding the equation to, and the properties of, the curves which give the ohm scale. Dials marked in this way are used in the Board of Trade panel on the switchboard of a central station. There is a great demand in America for the analogous instruments which give the volts, amperes, and watts on the same dial face. They are useful in electric motor-cars.

The introductory chapters on "Errors and Accuracy" are most helpful. A diagram (p. 9) is given of a scale where the unavoidable error of observation produces the same percentage inaccuracy at all points of the scale. We take it that if R is the reading and x the distance of the pointer from the unit mark on the scale, then $R=a^x$ gives the law according to which the scale is divided, a being a constant. The divisions on this scale, ordinarily called a logarithmic scale, are obviously much further apart at low readings than at high readings. We were surprised to learn that the definition of the percentage error e "usually adopted in this country" is given by

$$\text{True value} = \text{Reading } (1 + e/100).$$

We should have thought that the academic definition

$$\text{Reading} = \text{True value } (1 - e/100)$$

was more widely used.

Amongst the instruments described are all types of ammeters, voltmeters, wattmeters, frequency tellers, synchronising devices, recording instruments, speed indicators, oscillographs, pyrometers, relays, rail-bond testers, etc. Descriptions are also given of meggers, ohmers, ducters, graphers, etc. These names are not schoolboy slang, but are in everyday use by engineers. In the old days anyone who could talk about an "earth" or a "short-circuit" might rank as an electrician; now he must be able to define the meaning of quaint phrases like "milking booster."

On p. 384, when describing instruments for testing lightning conductors, the author says that the earth should on no account exceed 10 ohms. Is there any reason why the number 10 should be chosen rather than, say, 1 or 100? The present writer once measured the earth resistance of a lightning conductor on a chimney-stack and found it to be 70 ohms. He had the end dug up, and found that the electrician had put a brick instead of the usual copper plate at the end of the conductor. This had been done twenty years previously, but although the stack had been repeatedly struck by lightning, no damage had been done. It would probably have fulfilled its functions equally successfully for another twenty years if the brick had been left undisturbed.

In conclusion, we congratulate the author on the clearness of his descriptions and on the skill with which he exposes the weak points in the design of several well-known instruments. The diagrams are worthy of the highest commendation, and the printing is good. There are a few misprints. The only serious one is on p. 183, where there are two errors in the formula for the electrostatic attraction between two plates. On p. 404 also lines 4 and 5 from the bottom of the page should be interchanged.

A. RUSSELL.

OUR BOOKSHELF.

Modern Engineering Measuring Tools: A Handbook on Measuring and Precision Tools as used in the Modern Tool-room and Engineering Workshop. By Ernest Pull. Pp. viii+115. (London: Crosby Lockwood and Son, 1918.) Price 4s. 6d. net.

PRIOR to the outbreak of the war there were still a large number of engineering firms in this country which had not adopted systems of precision in the manufacture of component parts. War conditions have altered this so far that there must be very few firms now which have had no experience in precision methods. It is to be hoped that there will be no retrogression in this important matter now that the war is practically over.

This book is intended to help workmen to acquire a practical acquaintance with the construction and use of the commoner types of measuring appliances as employed in tool-rooms and engineering workshops. It includes sections dealing with the use of micrometers, verniers, various special appliances such as depth-gauges, screw-thread micrometers, etc., gauges and gauge systems, and types of measuring machines. The sections dealing with micrometers and verniers are arranged in a specially helpful manner, and contain many diagrams showing the instruments set to various readings, including those cases which present difficulties to beginners. There is also a good description of the Johansson system of standard gauges and the methods of using these gauges, and there is sufficient matter included on the subjects of limits, tolerance, and limit-gauges.

Omissions are inevitable in a small book of this kind, and there are many special appliances developed during the war which do not find a place. The success which the author has attained in this and his companion book for munition workers should encourage him to undertake a more comprehensive volume in which laboratory as well as workshop methods might find a place.

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.]*

Fuel Economisers.

DR. AITKEN's letter in NATURE of December 12 calls to my mind some unpublished experiments which I made at the National Physical Laboratory in connection with some work on radiation from surfaces, which entirely bear out his statement that the colour of a hot surface at relatively low temperature has very little influence on the amount of radiation leaving it. This is a conclusion which, *a priori*, one would not consider very probable, yet is actually found.

In a series of experiments the sides of a thin cubical metal canister were painted in panels of varying colour, the interior of the cube being filled with rapidly stirred oil electrically heated. The amount of pure radiation leaving each kind of surface at a series of steady temperatures up to about 200° C. was compared with that coming at the same temperature from a "black body" constituted by a re-entrant tube with appropriate diaphragms. The exterior of the tube was washed by the hot oil. For temperature differences in the region of 100° C. it was found that:—

(1) A bright surface of ordinary tin-plate only gave off an amount of radiation equal to 5–10 per cent. of that from a "black body." The quality of the optical perfection of the surface was of little importance so long as it was bright. A metal surface treated with galvanit of various kinds showed effects of the same order as tin-plate. Burnished copper well cleaned with metal polish gave a lower intrinsic radiation than tin.

(2) A coat of almost any paint, regardless of colour, brings the true radiation up to from 80–90 per cent. of that of a "black body," and a quite thin layer of paper varnish or of celluloid varnish, so thin and transparent as to be almost imperceptible to the eye, applied over the bright metal, has almost the same effect.

(3) A layer of tissue-paper or wallpaper pasted over the bright surface, or a coating of whitening or lime-wash, shows the same kind of effect in restoring practically the full radiation so long as the coating is thin.

(4) If the surface of the cube be metallised with aluminium paint, the pure radiation is reduced to from 45–55 per cent. of that of a "black body." Much depended, however, on the kind of vehicle used for the aluminium, and different samples of aluminium paint, though giving results similar in appearance to the eye, differ considerably in the effects produced. Bronzing and such-like processes produce intermediate effects.

In some later experiments, with which Mr. Ezer Griffiths was associated, a study was made of the total heat-leaving surfaces, with the view of obtaining some data as to the relative effects of conduction, convection, and radiation in ordinary still air. From these experiments it would appear that in the case of low-pressure steam radiators in the region of 100° C., almost exactly half the heat leaving the vertical surfaces, if these are of an ordinary character or painted in the usual manner, consists of pure radiation, the remainder being the combined effect of conduction and convection. Therefore, if, as is a very common practice, the radiators be metallised by painting with aluminium paint, the amount of heat reaching the middle of a room warmed by such radiators would be lowered to half, or double the amount of heating surface would be required to produce the same radiation effect as if the surface were black or of bare metallic iron. These results certainly have an important bearing upon the practical problems of heat transfer.

In the course of a recent perusal of Leslie's "On Heat" I have been much struck with the fact that many of these things were by no means new to him a hundred years ago. His very suggestive and interesting researches do not appear to be anything like so well known as they certainly deserve.

J. A. HARKER.

Munitions Inventions Department,
Princes Street, Westminster, S.W.1.
December 17.

MY attention has been directed to the note in NATURE of November 28 (p. 249) referring to Prof. C. V. Boys's fuel economisers, and also the letter by Dr. John Aitken in the issue of December 12; and as I devoted some consideration to this question about twenty years ago, a description of the apparatus I then devised for a similar purpose, and the results obtained with it, may be of interest.

In order to heat this house, which is a cold one, and finding that the open fireplace in the hall consumed much fuel with little heating effect, I fixed an open fire-stove in front of the existing fireplace. I then fitted a wrought-iron closed box, 3 ft. high, 2 ft. broad, and 9 in. deep, at the back of the stove in the recess in which the fireplace previously existed.

The chimney of the stove was connected to the box near the top at one side, and an outlet connected to the box on the other side, which was led up the chimney. As this outlet-pipe is much smaller than the existing chimney, an iron plate was fixed across the intervening space so as to block it against the entry of air except through the stove.

This box was divided vertically into two equal compartments by a plate extending from the top to within 6 in. from the bottom, so as to ensure that the hot gases flowed past the internal surfaces of the box and imparted their heat to them. At one side of the box near the bottom was fixed a door in case it should be necessary to remove any soot that may have accumulated in it.

The stove is lighted in the usual manner with a little coal, and a coke-fire is maintained thereafter. The iron box soon becomes heated by the gases issuing from the stove, which without the addition of the box would have passed direct into the chimney, and the air of the room circulating around its external surfaces becomes heated, and that of the hall warmed.

The saving of fuel by the adoption of this contrivance is very marked, as is proved by the fact that the temperature of the products of combustion when they leave the box is considerably lower than when they enter it.

The apparatus, which is not unsightly, as it is practically concealed by the ornamental stove in front of it, has been in operation for the past twenty years without causing any trouble or requiring any repairs.

Now fuel is scarce, economisers such as the one described might be adopted with advantage.

R. C. PARSONS.

48 Princes Gardens, South Kensington, S.W.7, December 16.

The Perception of Sound.

I WOULD beg permission to add a brief correction to my remarks relative to the quotation from Helmholtz given by Sir Thomas Wrightson, since I may have been guilty of some misunderstanding. Sir Joseph Larmor has been kind enough to explain to me how the relation between the wave-length of the vibrations set up in a closed volume of liquid by a vibrating body immersed in it and the dimensions of this body is of importance in the case of the cochlea.

The time taken by the compression to travel from the oval window to the round window is so short in comparison with the wave-length that there can be only a very minute difference of pressure between the two sides of the basilar membrane due to this cause. The movement of the fluid as a whole will be the means by which the membrane is set into backward and forward movement. If different parts of the membrane, however, have their own rates of vibration, these parts would be set into resonant vibration by the appropriate rates of alternation of current, on account of the differences of pressure on the two sides of the membrane implied by the flow of liquid. The quotation from Helmholtz seems to suggest that he had come to look upon these movements of the liquid as the actual exciting cause of the local resonance. If so, it may be that the most satisfactory solution of the many difficulties of the case is in a combination of part of Sir Thomas Wrightson's view with the resonance theory of Helmholtz.

W. M. BAYLISS.

The Meteoric Shower of December.

THE weather proved very unfavourable for observation during the first half of December this year, and I watched for a return of these meteors on three nights only, viz. the 6th, 8th, and 9th. The temperature was unusually high for the period, the mean being 49·5°, and about 9° in excess of the average. Few Geminids were recorded on December 6, but on December 8 and 9, between 13h. and 15h., they were more numerous, and the place of the radiant admitted of accurate determination. There seems no question that the position moves to the eastward, with the time, similarly to the Lyrid and Perseid radiants. From observations obtained at Bristol in recent years the Geminid centre came out as follows:—

		R.A.	Dec.
1916 December	3	102°	+32°
1912	6	$104\frac{1}{2}$	+33
1914	8	105	+31
1918	8	107	+32
1918	9	108	+33
1914	12	109	+33
1915	12	110	+33
1917	12	112	+33
1914	15	114	+33

W. F. DENNING.

Bristol, December 18.

Lady Roberts's Field Glass Fund.

MAY I, through the hospitality of your columns, ask all officers and others who have received glasses or telescopes on loan through my Fund to send them back to me now for return to their owners? All instruments lent through my Fund bear the letters N.S.L. (National Service League), followed by a letter and a number. I should be glad if officers and others returning glasses would enclose in the case a note of acknowledgment for the owner.

I wish to record my gratitude, not only to the public for the munificent loan of 30,000 glasses, but also to the Press for the valued help which it has given this undertaking.

The address for glasses and correspondence is the Manager, Lady Roberts's Field Glass Fund, 64 Victoria Street, S.W.1.

ROBERTS.

INTER-ALLIED CONFERENCE ON INTERNATIONAL ORGANISATIONS IN SCIENCE.

THIS important conference was held in Paris on November 26–29. Primarily, it was a conference of the Committee of Inquiry (*Commission d'Etudes*) which was constituted at a meeting of representatives of academies of the Allied countries and the United States of America held in London, on the invitation of the Royal Society, early in October last.

The Committee of Inquiry was to "prepare a general scheme of international organisations to meet the requirements of the various branches of scientific and industrial research, including those relating to national defence." At the London conference certain resolutions had been passed and proposals submitted, and the duty of the Paris conference was to weld these into a workable whole and generally to establish on a sound basis an international council or federation of national councils which would be representative in each country of academies and other scientific societies.

The names of the delegates, who met in Paris to the number of forty-seven, are given in the following list:—*Belgium*—MM. Lecointe, Massart, de la Vallée Poussin; *Brazil*—M. de Carvalho; *France*—MM. Painlevé, Guignard, E. Picard, A. Lacroix, Lippmann, E. Perrier, Roux, Haller, Bigourdan, Baillaud, Lallemand, Moureu, Flahault; *Italy*—Sen. V. Volterra, Profs. Reina, Nasini, Ricco, Fantoli; *Japan*—Profs. Tanakadate and Sakurai; *Poland*—M. L. Mickiewicz; *Rumania*—MM. Soutzo, Hurmuzeco, Mrazee, Marinesco; *Serbia*—MM. Zujovic, Petrovitch, Jopovitch; *United Kingdom*—Prof. Schuster, Mr. J. H. Jeans, Sir Frank Dyson, Sir E. Sharpey Schafer, Profs. Frankland, Sherrington, and Starling, Col. Lyons, Dr. Knott; *United States of America*—Prof. Bumstead, Col. Carty, Drs. Durand, Flexner, Hale, Noyes. Although the Academy of Athens had not been able to send representatives, Greece must also be included in the list of countries invited to form national research councils.

On the morning of Tuesday, November 26, the representatives met in the Academy of Sciences, and were welcomed in a short address by M. Painlevé. It was then proposed that Prof.

Schuster should act as president of the conference, and M. Lallemand as secretary.

Having unanimously agreed that all present arrangements must be regarded as provisional, the committee, acting along the line of the resolutions passed at the London conference, assumed temporarily the title of the International Research Council, and proceeded to embody its findings in a series of resolutions, the leading features of which need only be referred to.

An Executive Committee of five was elected, consisting of MM. Picard (chairman), Volterra, Lecointe, Hale, and Schuster, the seat of the bureau to be in London. The powers of this committee were formulated on a wide basis so as to enable it to carry out effectively the objects aimed at in the resolutions of both the London and the Paris conferences. So soon as this committee considered that things were sufficiently matured, the International Research Council would be convened so as to take the necessary steps towards assuming its final form as a Federation of National Councils. Meanwhile, the Executive Committee was to examine proposals for the formation of new international scientific associations submitted to it by any academy represented at the conference, or any group of delegates of such an academy or of a National Research Council. For the thorough examination of these proposals the Executive Committee would appoint special committees, the members of which need not be members of the International Research Council. In all cases the endeavour would be to get the most suitable persons to serve on these special committees.

In thus laying the foundation for the establishment of effective organisations of an international character, the International Research Council emphatically declared that there was no intention of interfering with individual enterprise. On the contrary, since all great advances in science are initiated by individual efforts, the International Research Council regarded it as one of its important functions to give every possible encouragement to those capable of conducting scientific research of a high order. It was also clearly recognised that with respect to the initiation of new international associations or to the revival of old ones no decision could be arrived at without consulting bodies or persons specially interested.

Definite progress was made in the institution of three associations: (1) Astronomy, (2) Geophysics, (3) Union of Chemical Societies. These might be taken as typical examples of the many other associations to be formed hereafter. It will suffice to direct attention to one of these, say the second named above.

It is proposed to form, among the States which have been at war with Germany, an association, to be called the International Geophysical Union, having for its aim the development, in their respective territories, of all useful work in connection with the physics of the globe. Geophysics is understood to include geodesy, meteorology, terrestrial magnetism, and seismology. This union (or each of its sections) is to be controlled by an international committee composed of delegates from national councils, which will consist of representatives from scientific societies specially interested, and of delegates appointed by the respective Governments. The number of delegates from each State serving on the International Committee will be determined by the population of the State, according to this scheme:—Fewer than 5,000,000 inhabitants, one delegate; between 5,000,000 and 10,000,000, two delegates; and so on up to five delegates for a population exceeding 20,000,000. Each State will contribute towards the expenses of the International Committee definite sums regulated according to the number of inhabitants of the State. Each union or association will have its own bureau, with president, vice-president, and secretary; and meetings will be held at least once every three years. The union once constituted, any nation which has been at war with Germany may formally enter the union on agreeing to the conditions laid down. Any neutral nation desirous of ultimately entering the association can be admitted only by a three-fourths vote of the countries represented on the International Council. The present agreement may be revised on the request of half the members of the International Council, any proposed modification requiring a two-thirds vote in its favour.

In addition to the resolutions which were debated and passed, certain proposals were laid before the International Research Council bearing upon such questions as international exchanges of publications, internationalisation of great laboratories, comparison of university programmes of study, the publication of authoritative abstracts of scientific papers and the whole bibliography pertaining thereto. Undoubtedly extremely useful work could be effected along these lines, but much spade work must needs be done by well-chosen enthusiasts.

At present the main consideration is the practical success of the movement which has been inaugurated. The Executive Committee has ample powers to get into touch with all kinds of scientific academies and societies, inaugurate special committees which have power to add to their numbers, and encourage the formation of national councils the federation of which will form the International Council. This Executive Committee, it must be remembered, is a temporary body, which will naturally dissolve when the International Council is finally constituted. Its five members are known to be keenly interested in the whole question of international scientific work, and the task of establishing effective international organisations could not be in better hands. Their efforts must, however, be supplemented by all scientific academies, societies, and unions entering heartily into the movement, and aiming at the formation of international associations in all branches of science, physical and biological, in the widest sense of these terms. The first great step has been taken. In carrying the project out to a successful finish, men of science must see to it that the new organisations are not hampered by conditions which in certain instances marred the efficiency of former international organisations of a similar kind. C. G. K.

OUR ROADS.

IN view of the generally accepted reconstruction programme of rehousing our working population and providing small holdings for a large number of the men from our fighting forces when they are released from service, the question of our roads and their extension to give access to the proposed new factories, workers' houses and gardens, small farms and allotments is of great interest, and has attracted much attention, several papers dealing with this matter having been recently read and discussed by the Institution of Civil Engineers.

It is evident that the transport facilities for collecting and distributing goods into these transformed rural districts must be such that the country resident is as nearly as possible on an equality with the townsman. It is equally evident that this distribution of goods cannot be given by extending our railway system, whether by branch lines of standard gauge or by narrow-gauge feeders, as has been the case in France and Belgium; for, however much we extend a railway system by light railways or tramways, these can only collect and distribute produce up to the point reached by the rails themselves, and thus a railway system *per se* can serve but a very small part of the land area. In fact, a well-extended road system which connects every door by road wagon is in a sense comparable with the sea, which connects every port in the world by our ships.

The future extension and improvement of means of transport by road are, therefore, of first importance. It is interesting at this stage to review the work already carried out in road-surface improvement by the local authorities themselves or in cases where these authorities have been aided by the Road Board. A great deal was done in the improvement of road surfaces during the ten years immediately preceding the war. Many new methods of waterproofing the surfaces, first by using coal-tar and pitch, and later on by bitumen, were tried on a large scale. Although we hear through the Press that our roads have suffered terribly from the war, and that the shortage of labour and restrictions on the use of road materials, combined with the motor traffic, have resulted in the breaking-up of the road surfaces to such an extent that vast sums will be required to put them into a fit state to carry the increased traffic which is expected during the reconstruction period, this is not true as regards the improved roads. As a matter of fact, the improved road surfaces which had been developed previous to August, 1914, have stood the severe strain of carrying the increased war traffic remarkably well. For instance, if we take the main road from London to Folkestone as an example of one which has been daily traversed by heavily laden trains of motor-wagons carrying war material, this road has practically had no money spent on it, its surface is as good as it was at the commencement of the war, and, what is interesting from a sanitary point of view, it has been self-cleansing, the rainfall doing all the scavenging that was necessary. Fortunately, we have before us many similar examples of the substantial correctness of the methods which were developed just previous to the outbreak of war. The damage on which so much stress has been laid by the Press has been almost entirely confined to the old, unimproved water-bound roads, which must now be taken in hand.

The newer roads, however, differ from the older roads in one feature, *i.e.* that the use of pitch and bituminous materials for binding the road stone together has given an entirely new aspect to the process of repairing and maintaining our roads. The old water-bound roads wore out by the material being ground away by the traffic, when it was wetted by the rainfall, so that the stones could move on one another, and instead of remaining angular they lost their corners and tended towards the spherical shape we see in water-washed shingle. The pitch or bituminous binding introduced reduced this wear to a great extent, but in place of it introduced a new trouble: it was often the case in the experimental work when pitch was used as a binder that the roads were found to become corrugated by the traffic; harmonic waves were formed on their surfaces, and these waves could be levelled only by breaking up the surface and relaying it—an expensive process.

Road engineers are by no means unanimous as to the causes of this wave formation. Some of them blame the particular process employed for preparing the material and finishing the surface by rolling, but all have noticed the bad effect of the synchronising or harmonic action of vehicles passing over them, especially when the majority of these are exactly of the same class, which is the case when a line of motor-omnibuses begins to work on a road previously traversed by heterogeneous traffic. It is unnecessary to dwell on this point, nor is it important, for it is certain that corrugation or wave formation *always* results from the rolling action of wheels on any surface, even of hard steel wheels on steel rails, as is shown by the corrugation of railway and tramway rails.

The study of the harmonic effects of wheels rolling over surfaces of varying degrees of rigidity and elasticity is a large and very interesting question which cannot be discussed within the limits of this article. It is more important to know what can be done to limit its effect on road surfaces. During the years of the war the question has been much studied, and some excellent results have been obtained in Scotland by Mr. Robert Drummond, the engineer of the Paisley roads, who has devised methods by which the stones forming a road surface can be wedged into position by simple and inexpensive methods, and then waterproofed by pouring a very small quantity of pitch over the wedged surface. Roads so made have stood the heaviest traffic with a minimum of deformation. It is practically certain that Mr. Drummond's method, hitherto worked by hand, can be carried out still more efficiently by machinery. This will undoubtedly be done and will greatly reduce the cost not only of resurfacing the vast mileage of roads which must now be taken in hand, but also of the great extension which must be undertaken, as foreshadowed in the early part of this article, to enable country districts to be opened up. In conclusion, if, twenty years ago, anyone had stated that the extension of roads was even more important than the extension of railways, he would have been looked upon as a visionary; but this is now actually the case.

Since the above was written, the announcement has been made that the Government, acting on the recommendation of the Road Board, has allocated 10,000,000*l.* to our roads and bridges. We are not informed whether Ireland is to share in the grant, but it is stated that the greater part is to be spent on roads, as the bridge improvements can be carried out by the local authorities, borrowing for this purpose on long-term loans. Ten million pounds is a large sum, but it will be found sufficient only to resurface about one-quarter of the main roads of England, Wales, and Scotland so as to bring them to an equality with the improved roads we have mentioned, even if the most economical methods now known are faithfully followed.

This grant is sufficient for a commencement. It will give employment to many demobilised men as they return from overseas, but it is to be hoped that the Government or the Road Board will see to it that really scientific training is given to the executive staff which is to carry out the work. The special local knowledge of climatic conditions, local road stones, and so forth, which used to form so large a part of the qualifications of our local road surveyors, will no longer suffice. As we have shown, the road engineer has now to deal with scientific questions which ought to be determined for him by the central authority, which is at present the Road Board; it is to be hoped, therefore, that the instructive experimental work commenced by it previous to the war will be at once renewed, so that the methods of resurfacing the roads of the kingdom may be to some extent standardised.

Road problems are already so specialised that our universities might with advantage follow the example of some of the American universities by instituting special courses of lectures on highway engineering.

THE AMERICAN CHEMIST IN WARFARE.

UNDER the above title Dr. Charles L. Parsons, chairman of the U.S. Committee on War Service for Chemists, communicated to the American Chemical Society, at a recent meeting at Cleveland, a paper which is reproduced in our contemporary *Science.* As the paper bears directly upon matters of national importance, and is of interest as showing the promptitude and thoroughness with which our Ally dealt with a great and critical emergency, it may be desirable to give a short summary of its contents.

Some months before the United States entered the war Dr. Parsons was sent by the Ordnance Department to study in England, France, Italy, Norway, and Sweden certain chemical processes, particularly those relating to the fixation of nitrogen. When he arrived in England he was strongly impressed with the dangerous position in which this nation stood owing to the policy of the War Office in drafting practically every available man, irrespective of his qualifications and potential value, into the combatant ranks. Perhaps at the time no other course was possible. It was absolutely necessary to stem the rush of the enemy, and men were required to do it. Meanwhile, the Government was halting between two opinions—shilly-shallying with the question of conscription, and "letting *I dare not* wait upon *I would.*" The consequence was that owing to the lack of technical men, chiefly chemists, the supply of munitions was greatly retarded. This was no less true of France. Everywhere the same statement was made that the greatest mistake of the Entente countries was in giving too little attention to brain power and too much to physical prowess. Germany, on the other hand, had carefully conserved her chemical strength in order to develop the new and terrible methods of warfare which her policy of "frightfulness" forced upon the world. We were ultimately reluctantly driven to fight her with her own weapons, and to better her example, if we could.

The war, in fact, entered upon a new and utterly unexpected phase for which this nation was very inadequately prepared, and with which the War Office, as then constituted, was quite unable to cope. Practically the whole chemical force of the Empire was called upon to grapple with the position. How our difficulties were at length surmounted, and how our chief enemy was eventually compelled to regret that he had ever embarked upon such a mode of warfare, will perhaps some day be made fully known. It is a chapter in the history of the war not only of present interest, but also of future value. There is no question that before this consummation was reached we were for a time in great jeopardy. Indeed, it was necessary for all the Allies to seek for chemists and chemical engineers wherever they could be found. France secured the services of Norwegians; England drew upon her colonies and her oversea possessions. Dr. Parsons, indeed, says that "the chemist who perhaps more than any other in England is responsible for the success of England's munitions programme is an American."

This lesson was not lost upon the authorities of the United States when it was recognised that they would be forced to take their part in crushing the great conspiracy against the freedom of the world. How they took it to heart is the purpose of Dr. Parsons's paper to show.

In the first place they at once instituted a census of American chemists. It was started in February, 1917, and was kept up without interruption. By July, 1917, some 15,000 chemists had sent in particulars of their address, age, place of birth, lineage, citizenship, dependents, places of instruction, chemical experience at home or abroad, military training, publications, research work, etc. The data obtained were indexed and cross-indexed by the American Chemical Society working in conjunction with the Bureau of Mines. When America entered the war every chemist was directed to keep the society informed as to his military status and duties. The president of the American Chemical Society had already offered without reservation the services of its members to President Wilson in any emergency that might arise. The society recommended the use, in their respective fields, of all trained chemists, and urged that those of special ability should be held to the work they could best perform. Influential committees of representative men were formed to consider how the war service of chemists could best be made, and a plan for the "Impressment of Chemists and for the Preservation of the Supply of Chemists" was drawn up, and the aid of the technical Press was enlisted in making known the procedure. A large number of the chemists engaged on war work were obtained by means of the classified list. Practically all the chemists who early entered the Ordnance Department with commissions were obtained through the American Chemical Society or its officers. The list was equally useful to the Bureau of Mines when it entered upon the subject of gas-warfare. All the bureaux and departments in Washington consulted it from time to time as the necessity arose.

From the first (says Dr. Parsons) the chemical *personnel* of the Army and Navy and the civilian bureaux was partly civilian and partly military. As the war progressed the proportion of chemists in uniform naturally increased as the men were taken from the Army and assigned to chemical duty. The question is still a disputed one—to be settled probably only when the war is over—as to whether a chemist can serve best in a civilian or a military capacity. Certainly in both capacities the demand for chemists has been unprecedented, and the development of chemistry in modern warfare to those in touch with the advancement made seems almost a fairy-tale.

Considerations of space forbid the attempt to follow in detail Dr. Parsons's account of the various organisations for co-operative research which were instituted in practically every university and polytechnic throughout the States, nor can we deal fully with the story of how the various sections and sub-sections of the chemical warfare service were eventually organised and co-ordinated. This service was ultimately established as a unit of the national Army, being, Dr. Parsons claims, "the first recognition of chemistry as a separate branch of the military service in any country or any war."

Dr. Parsons pays a well-merited tribute to the zeal and sense of duty with which practically the whole of the chemical profession in America entered upon this work. "The organisation was rapidly built up and contained the names of the most prominent chemists in the country, as well as those of hundreds of young chemists who will later become prominent."

In reading this interesting story it is impossible to avoid being struck with the evident ease with which the civilian element was promptly merged into and made to co-operate with the bureaucracy when the necessity arose. It may be that in a democracy like America public departments are more in actual touch with the public than with us. There is seemingly less of that aloofness and jealousy of outside interference and advice which are apt to characterise our public offices. The Civil Service of America is not less highly organised than our own, and as regards its knowledge and appreciation of modern necessities and conditions it is, perhaps, in some respects, better equipped. That our Government offices have something to learn in this respect is evident from the considerable importation of "business men" into the Government service that it has been necessary to make during the last four years. It cannot truthfully be said that all our public departments have invariably risen to the emergencies with which they have had to deal, and certain of those most directly concerned with the conduct of the war, and with the conditions which have arisen out of it, have been most faulty in this respect. It may be, to adopt the Prime Minister's phrase, they have too many "vested prejudices" to contend with.

We have now had the story of the American chemist in warfare from one who is well qualified to tell it. May we not hope that before very long someone equally well qualified to deal with the experiences of his English *confrère* may give us a similar account? The record may not be quite so satisfactory in all respects, as our cousins had our mistakes to warn them and our experiences to guide them, as Dr. Parsons admits. But in spite of mistakes, and of a certain tardiness on the part of those entrusted with the conduct of the war to realise the importance of chemistry in modern warfare, and to welcome the skilled assistance which was offered them, the story is highly creditable to us, and will bear comparison with that of which a short account has been given. As already stated, it constitutes a chapter in our section of the history of the war, and should be made known for the satisfaction of those who have lived through the anxieties of the past and for the instruction and benefit of those who come after us.

T. E. THORPE.

NOTES.

THE announcement of the appointment by the Department of Scientific and Industrial Research and the Medical Research Committee of a Research Board to investigate the conditions of industrial fatigue comes as a welcome reminder that the importance of fatigue in industrial processes, long insisted on by those engaged in its investigation, can no longer be neglected. Fatigue, indeed, forms the dominating factor in limiting output, and its investigation during the war established facts of fundamental importance. It is right that these researches should now be co-ordinated and extended to other industrial processes where, up to now, fatigue has not been adequately investigated. The Board consists of:—Prof. C. S. Sherrington (chairman), Mr. E. L. Collis, Sir Walter Fletcher, Mr. W. L. Hichens, Dr. Edward Hopkinson, Mr. Kenneth Lee, Dr. T. M. Legge, Col. C. S. Myers, Mr. R. R. Bannatyne, and Mr. D. W. Wilson (secretary). The duty of the Board will be to initiate, organise, and promote, by research, grants, or otherwise, investigations in different industries with the view of finding the most favourable hours of labour, spells of work, rest pauses, and other conditions applicable to the various processes, according to the nature of the work and its demands on the worker. The Board will be glad to receive suggestions as to any problems of the kind described. All communications should be addressed to the Secretary, Industrial Fatigue Research Board, 15 Great George Street, Westminster, S.W.1. It is a hopeful sign that, in industrial research, employers are convinced of the need for progress, and, should undue delay occur, they will be prepared to take into their own hands the prosecution of investigations and the application of results.

TEN years ago Wilbur Wright gave at Le Mans, western France, a demonstration of the practicability of aerial navigation with machines heavier than air. On Sunday, December 22, we learn from the *Times*, this notable achievement was celebrated by the laying of the foundation-stone of a monument to Wilbur Wright, erected by the people of Le Mans, in the Place des Jacobins, at the foot of the rising ground on which the cathedral stands, the presentation of a commemorative tablet to Le Mans by the Aero Club of America, and a memorial tablet and bronze wreath from the citizens of Dayton, Ohio, Wilbur Wright's birthplace.

THE President's gold medal of the Society of Engineers has been awarded to Mr. T. Roland Wollaston, of Manchester, for his paper on "A Survey of the Power By-product Problem."

THE *British Medical Journal* announces the resignation of Prof. E. Roux of the directorship of the Pasteur Institute, Paris, and the appointment of Dr. A. Calmette as his successor.

IN an article on reconstruction, in the *Scientific American* for November 23, the Hon. W. C. Redfield, Secretary of Commerce to the United States, gives a short account of what is being done in the States to restore industry to a peace basis and to improve it in the future. Mr. Redfield points out that the industrial success of Germany arose out of two causes—first, the appreciation of the science which underlay each industry, its study and its application in the industry; and secondly, the training of the mind as well as the hand of the worker, so that he should understand both *how* to do a thing properly and *why* that was the proper way. Neither in Great Britain nor in America has scientific research or vocational training been conspicuous, or even visible, in industry. Both are now being introduced in America as quickly as possible. Experimental cotton and woollen mills, a paper mill, and a rolling mill have already been established, and other industrial laboratories are to follow, so that any problem which affects a whole industry can be at once worked out on a practical scale. The Federal Board for Vocational Education is distributing large and increasing sums to each State of the Union to ensure to every worker a knowledge of the *why* of his work.

AT the meeting of the Illuminating Engineering Society on December 19 some particulars were given, by permission of the Ministry of Munitions, of researches which have been undertaken by two committees on the illuminating value of flares, parachute lights, etc., and on the brightness of self-luminous radio-active material. Mr. A. P. Trotter, who dealt with the former problem, showed several forms of photometers specially designed to deal with the fluctuating and very powerful light of these service flares, which in certain instances attained 130,000 c.p. The work had to be done exclusively on moonless nights, and, as experiments were conducted in the open, precautions had to be taken against the disturbing effects of wind, mist, and smoke. Several interesting results of these experiments are mentioned. It appears that nests of parallel flares give substantially a candle-power equal to the sum of the values of the constituent flares; also that the light is of the same value at different angles below the horizontal; in other words, such flares act as flames, and not in a manner resembling the crater of an electric arc. As a rule, sample flares were mounted on high poles, but they were also attached to the carrier of a military kite with the object of ascertaining the illumination that would be produced in practice when such flares are dropped from aeroplanes. The second series of experiments, described by Mr. W. C. Clinton, related to the decay in brightness of compositions containing zinc sulphide with a small admixture of radium bromide in course of time. Experiments extending over a year showed that specimens containing from 0·1 to 0·8 mg. of radium bromide per gram of composition all eventually possessed a brightness of the order of 0·01 foot-candle, though originally the compositions with the higher radium content were much the brighter. Experiments were made to determine the desirable depth of material by which the brightness and life are also affected. In view of the costliness of radium, such experiments are most useful in determining the minimum amount which can be usefully employed in practice. Both series of experiments afford an instructive instance of the useful work undertaken by many scientific societies during the war.

THE Registrar-General's return for the week ending December 14 shows a continued decline in the influenza epidemic. The deaths in the ninety-six great towns of England and Wales were 1885, which is only a little more than one-half of the deaths in the preceding week, and is lower than in any week since that ending October 12, about the first week of the epidemic. In London the deaths were 322, which is less than one-half of those in the preceding week, and also fewer in any week since that ending October 12, which was the first week in which the number of deaths in London exceeded twenty. The *Times* of December 18 gives the following as the "influenza world-toll," from its medical correspondent:—"Though estimates of deaths over the whole world from any single epidemic are very difficult to form, there seem to be reasonable grounds for believing that some 6,000,000 persons have perished of influenza and pneumonia during the past twelve weeks. . . . Never since the Black Death has such a plague swept over the face of the world; never, perhaps, has a plague been more stoically accepted. In India alone more than 3,000,000 deaths occurred. Bombay had 15,000 of these; Delhi, with a population of only 200,000, had 800 deaths a day; the Punjab lost 250,000 persons. South Africa suffered no less severely."

The death is announced, at eighty-three years of age, of Dr. Artemas Martin, of the U.S. Coast and Geodetic Survey. From an obituary notice in *Science* we learn that early in life Dr. Martin began contributing problems and solutions to various magazines. In 1877, while engaged in market-gardening for a livelihood, he began the editing and publishing of the *Mathematical Visitor*, and in 1882 he followed this up with the *Mathematical Magazine*. He also contributed numerous papers to other mathematical journals in America and abroad. He was an authority on early mathematical text-books, and collaborated with Dr. Greenwood in the "Notes on the History of American Text-books on Arithmetic." In 1885 Dr. Martin was appointed librarian of the U.S. Coast and Geodetic Survey, where his wide knowledge of mathematics made him of great service. In 1898 he was made computer in the Division of Tides, which place he held until his death. Honorary degrees were conferred upon him by several American universities, and he was a member of numerous learned societies. Dr. Martin's memory is to be perpetuated in the Artemas Martin Library of the American University at Washington, D.C., and at the same university there is to be an Artemas Martin lectureship in mathematics and physics, endowed by Dr. Martin.

We regret to record the death of Col. William Vincent Legge, who was born in Tasmania in 1840, and died there on March 25, 1918. Educated in England, France, and Germany, Col. Legge entered the military academy at Woolwich, and received a commission in the Royal Artillery in 1862. He early evinced his partiality for ornithology, and finally became a notable authority on that science. Of his thirty-five scientific papers, the first is to be found in the *Zoologist*, to which journal, in 1865, he communicated a paper on birds found nesting in Essex. From 1868 to 1877 he was stationed in Ceylon, and it was during this period that he laid the foundations of what was to be his *magnum opus*, namely, "The Birds of Ceylon," a large quarto volume of 1238 pages, with thirty-four hand-coloured plates depicting the endemic species, and a map showing the faunal areas. This valuable work was issued in parts between 1878 and 1880, and was largely based upon specimens which its author had collected. In 1883 Col. Legge returned to the family estate in Tasmania, and published a series of papers, chiefly on Australian birds. In 1884 he was president of the Australian Association, and delivered a suggestive address on the zoogeographical relations of the Ornis of the Australian sub-regions. He was one of the founders, and the first president, of the Royal Australasian Ornithologists' Union, a member of the Royal Society of Tasmania, and a Colonial member of the British Ornithologists' Union.

Dr. William G. Smith, Combe lecturer in general and experimental psychology in the University of Edinburgh, died on November 22, one of the many victims of the influenza epidemic. Dr. Smith was born on August 25, 1866, the youngest son of the Rev. Walter Smith, Half Morton, Dumfriesshire. Entering the University of Edinburgh in 1883, he graduated with first-class honours in philosophy in 1889, and afterwards acted for two years as assistant to the professor of moral philosophy. The foundations of a broader study of psychology in this country had just been laid by Prof. Ward's treatise in the "Encyclopædia Britannica" and William James's "Principles of Psychology," and the experimental methods of approach developed in Germany were also attracting the younger men. Dr. Smith spent fully two years in Germany studying experimental psychology, chiefly in Wundt's laboratory at Leipzig. He graduated Ph.D. in 1894 with a thesis on "Mediate Association," the substance of which appeared in an article in *Mind* in the same year. This was followed by another in 1895 on "The Relation of Attention to Memory," based partly on his Leipzig studies and partly on further investigations carried out in the physiological laboratory, Oxford, under Burdon Sanderson. In 1895 Dr. Smith went to America, and, after working some time with Münsterberg in the Harvard psychological laboratory, was appointed professor in Smith's College, Northampton, Mass. He held this position for some years, but eventually preferred to return to this country, where he became, successively, lecturer on psycho-physics in King's College, London, and assistant lecturer in physiology in the University of Liverpool. During these years Dr. Smith contributed a number of papers, based on experimental investigations, to the *Psychological Review*, the *Archives of Neurology*, *Mind*, and the *British Journal of Psychology*, in several of which he continued and extended his researches on memory. When an independent lectureship in psychology was established in the University of Edinburgh in 1906, he was chosen to be its first occupant, and his main energies since that time have been devoted to the equipment and organisation of the department. This he had carried through with marked success, and under his guidance the subject has taken an important place in the university curriculum.

The Journal of the Academy of Natural Sciences of Philadelphia (second series, vol. xvi., part 4, 1918) contains a finely illustrated monograph by Mr. Clarence B. Moore entitled "The North-Western Florida Coast Revisited." The aborigines of Florida were in the habit of "killing" the vessels interred with the dead by breaking a hole in the base, thus freeing their souls to accompany those of their owners to the life beyond. Doubtless the more thrifty mourners regretted this destruction of serviceable pottery, and hence arose a refinement of the custom, the manufacture of mortuary vessels of inferior ware, and provided with a basal perforation made before the firing of the clay. A large collection of these interesting vessels made by Mr. Moore is illustrated and described in this interesting monograph.

In *Folk-lore* (vol. xxix., No. 3, September, 1918) Dr. W. Crooke discusses the tales of the prentice pillars and the architect and his pupil. We have in this country instances of such pillars at Roslin Abbey and Melrose, and windows in Rouen Cathedral, where the story is current that the master, through envy, is said to have killed his pupil who constructed the work. In a second form of the tale the builder or architect is said to have fallen a victim to the jealousy of his employer, who feared that he might lose his reputation if the workman transferred his services to another master. Of this type of story numerous instances are quoted from India and other parts of the East. It has been suggested by Mr. H. A. Rose that the legend is based on the idea of a foundation sacrifice, the most appropriate victim being the person responsible for the work. But this does not easily explain some forms of the story, and further examples must be collected before the problem can be finally solved.

DR. A. PIJPER has described certain diffraction phenomena observed with cultures of micro-organisms by means of which the size of the organisms may be ascertained without direct measurement (*Med. Journal of S. Africa,* vol. xiv., 1918, p. 211). It was noticed that certain colonies of a bacterial plate culture viewed with ordinary daylight were colourless, but when the plate was held in the beam of an electric arc at a certain distance from, and at a certain angle to, the source of light, the colonies exhibited a blue colour. From theoretical considerations and control experiments the conclusion was arrived at that the coloration was due to a diffraction effect, the thin layer of micro-organisms acting like a grating. For the better observation of the effect the following arrangement was devised: The beam from an electric arc was parallelised by means of a condensing lens and passed through a hole in the proximal side of a closed box. In the box the bacterial plate culture was suspended, the glass of the dish being painted over with black paint except at one spot placed opposite the beam. Immediately opposite the transparent spot a second lens collected the rays, bringing them to a focus on a transparent screen forming the distal side of the box. On viewing the screen the spot in the axis of the beam is colourless, but around this a series of coloured rings spreads over the screen. Knowing the focal length of the collecting lens, and measuring the distance of any coloured ring from the axis, the size of the slits can be calculated, and, for spherical micro-organisms, the size of the slits is found to be just equal to the diameter of the organisms. This was verified by observations on various micro-organisms, the size found by the diffraction method and by micrometric measurement being practically identical.

THE last two reports of Bergens Museum, dealing with the years 1916–18, bear witness to a restriction of growth and activity caused by the war. In spite of this, much valuable work has been accomplished, and the educational influence of the museum has not lessened. Among recent accessions are several representatives of the anthropoid apes, notably a mounted group of male and female gorilla with young, and a fine skeleton of the male; a good mounted specimen of the wart-hog (Phacochærus); the Scandinavian herbarium of the lately deceased J. R. Landmark, who had continued to the end his donations of plants collected by himself in remote districts; numerous prehistoric remains from recent excavations, particularly a set of miniature greenstone axes, arrow-heads, knives, scrapers, and flakes from Vaagsø, Søndmør. Dr. A. Brinkmann, head of the zoological department, has started a collection of skeletons of the various races of Norwegian domestic animals, especially pedigree individuals, for which he hopes to obtain the co-operation and pecuniary help of the agricultural department. Such a collection, as was recognised by Sir Ray Lankester when director of our own Natural History Museum, is not merely of popular interest and practical importance, but has a value for the study of morphology and heredity. During the period covered by the reports the seismographic station connected with the museum has continued its work, and we think it well to conclude by quoting a sentence that appears in each report: "The Government has, on request, appropriated 4000 kroner to the acquisition and installation of a new seismograph, which will be purchased as soon as it is possible to obtain it from Germany." British instrument-makers should note this remark.

THE little-known grain called quinoa (*Chenopodium quinoa*) is the subject of an illustrated article in the July issue of the Bulletin of the Pan-American Union (vol. xlvii., No. 1), a journal devoted to all aspects of Latin America. It seems to be indigenous to the highlands of South America, where it has been cultivated since early times in Peru, Bolivia, Ecuador, and Chile. It is very hardy, and thrives well at altitudes of 11,000 ft., though in warmer climates it cannot compete with maize. The natives who grow quinoa use it in making a sort of bread, and it may also be treated like oatmeal or rice. Quinoa is still cultivated in a very primitive manner, and no attempts have been made to improve the grain by seed selection. The United States Department of Agriculture, however, is now experimenting with the grain in the hope of finding suitable areas where conditions of soil and climate will make it a profitable crop.

ENORMOUS quantities of timber have been used during the great war. In the first few months all available seasoned supplies were absorbed; for the remainder of the period green, unseasoned timber had to be employed, with the resultant inevitable high percentage of wastage through cracking and shakes. Large quantities of timber will be required for reconstruction purposes and restarting industries. The timber trade will therefore be in much the same position for some time to come. It will not be possible to await the period required for the natural seasoning of the material. There are several methods in operation for artificially drying timber by means of hot air. Mr. Herbert Stone in the *Quarterly Journal of Forestry* for October last discusses a method based on the use of cold air. The method is worthy of consideration. The plant required is a closed, double-roofed shed dimly lighted from the north. At the end farthest from the door a small refrigerating apparatus, such as is used in cold storage, though of smaller dimensions, is placed. By means of this a cold atmosphere is created sufficient to cause the air moisture in the shed to condense in hoar-frost, thus keeping the atmosphere continually dry. The moisture coming from the pores of the timber is thus constantly condensed in hoar-frost and got rid of, the wood drying without the risk of cracks and shakes, so often the accompaniment of hot-air drying. Mr. Stone is scarcely correct in his assertion that in the future most of our timber must be drawn from hot countries, where he recommends the method for trial. For one thing, our chief timber demands are for soft coniferous timber from the temperate regions; and, for another, the method, for various causes which will be readily appreciated by those having acquaintance with forestry conditions in the tropics, would be far more difficult of application.

THE American Geographical Society has published an index to the first sixty-four years of the Bulletin and Journal of the society. The periodical publications started in 1852, and for some years appeared intermittently, but apparently no annual index was published until 1895. The present volume will be welcomed by geographers as facilitating reference to a most valuable set of periodicals. There are references to both subjects and authors.

IN a most interesting paper in the October issue of the *Geographical Review* (vol. vi., No. 4) Mr. Edmund Heller descusses the geographical barriers to the distribution of big-game animals in East Africa. The paper is accompanied by a map showing the life-zones in the region. Mr Heller finds that climate is the chief controlling factor, and that it operates mainly in limiting certain vegetable growths which afford food and cover to animals. Large rivers, such as the Nile and the Tana, are important barriers to big-game mammals, but seem to have little influence on smaller mammals and reptiles. Crocodiles may assist in making a river a barrier to certain animals, though bushbucks, waterbucks, hippopotami, and elephants are not influenced by them. Antelopes and other ungulates seem to have a dread of water infested by crocodiles. The paper also considers the geographical aspects of the distribution of native tribes in East Africa.

M. MOUSSU, who made an investigational journey into north-east Morocco in 1917, has discovered a certain number of outcrops which point to the existence of petroleum deposits, especially as gypsum and gypsum-clays occur frequently in the neighbourhood. The three principal outcrops are at the Arab villages of Ouled-Slama, Kohlott, and Khaïrett. The principal of these outcrops was found at the first-named place, which is a short distance from the military station of the Tleta des Cheragas. The oils are probably of a heavy or bituminous nature. They ooze out of the ground in wet weather in the form of emulsion, and there is an absence of vegetation where they occur. From the main outcrop the writer was able to collect a few litres of the product. According to the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* for September–October, 1918, this product is a heavy brown (nearly black) oil, which rises in the form of emulsion in the salt-water of the watercourse. This sample was distilled at temperatures ranging from 90° to 225° C., and gave about 96 per cent. of distillates of a density of from 800 to 830, the result being a very pure kerosene. The quantity of ether and petrol is very small indeed. It is probable that these constituents evaporate owing to the heat at the surface of the outcrops. On the other hand, the yield of lamp-oil is very high and the residue very low. Since the outcrops discovered by the author extend over several kilometres, it is reasonable to assume the existence of others.

IN the *Zeitschrift des Vereines deutscher Ingenieure* for October 5 last Dr. G. Rohn discusses the question of Germany's textile requirements in the light of the feared economic boycott of that country by the Entente Powers, and briefly reviews what has already been accomplished in the way of finding substitutes. A certain amount of success has been attained in nettle cultivation. Although the yield of fibres from nettles is only 6 to 7 per cent. of the weight of the plant, the fibre has valuable properties, being very fine and smooth and strong. Since the war broke out some fifty processes for utilising nettle-fibres have been patented. It is thought that 1,000,000 hectares of low-lands could be planted with nettles, producing some 80,000 tons of fibres annually. The author also shows the progress made with wood-fibres, especially from the conifers. Experiments have been going on for some time with the view of extracting the fibres by chemical treatment, and success has rewarded the efforts of investigators in some directions. Developments have taken place, too, in the production of yarns from paper-stock, a number of companies having obtained licences to work the Türck Co.'s patents. The method of obtaining yarn from paper itself is outlined, and it is said that this method of treating wood is expected to render valuable service to Germany in future.

SINCE 1914 France has made great strides in the production of acetate of cellulose for use as an aeroplane dope, for kinematograph films, and for non-inflammable celluloids for various general purposes. The *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* for September–October last gives particulars of what has been accomplished in the manufacture both of the acetate of cellulose itself and of the acetic acid, solvents, etc. Various processes are employed, and the manufacture is carried on at a number of chemical factories which had had no experience in its production until the necessities of war made it imperative for them to take it up.

IN the Journal of the Washington Academy of Sciences for October 19 Mr. L. W. Austin describes a new method of using contact detectors in radio-telegraphic measurements. The sensitive vacuum and tellurium platinum thermo-elements have resistances which vary with the current, and are either slow in action or difficult to make and transport. They have therefore been replaced in the Naval Radio Laboratory of the United States by contact detectors in series with high-resistance galvanometers shunted by paper condensers of a microfarad capacity. The detector and galvanometer are shunted by a resistance of a few ohms. The sensitivity of the arrangement is greater than that of the best vacuum thermo-elements of the same equivalent resistance, and the deflections are proportional to the square of the radio current, except in the case of the galena detector, which shows a slight deviation from the law.

WHEN a canal connects two rivers situated at different levels, and the ordinary chamber lock is used to pass traffic from the higher to the lower level, the water taken from the higher-level stream is often considerable. A German firm has now patented a system of "dry" lock (*Zeitschrift des Vereines deutscher Ingenieure*, October 19 and 26, 1918), in which the ordinary lock-chamber is replaced by a concrete basin permanently filled to a definite level with water. In this are immersed powerful floats, also made of concrete, running on runners on the side of the basin. Connected by suitable means to the float is a trough, which carries the vessel to be transported from the high to the low level, or *vice versa*. The floats are capable of supporting the carriage, the trough, and the vessel transported. Now supposing it is desired to ship a vessel from the higher to the lower level, all that has to be done when the vessel is shipped into the conveying trough (by suitable gear) is to overcome the buoyancy of the floats by a suitable prime mover, *i.e.* the floats are immersed until the trough is on a level with the lower sluice-head. The reverse operation is followed when shipping from low to high level. An installation of this kind is now working on the Neckar-Danube Canal, and is said to offer considerable advantages over the ordinary system of lock or the various types of ferrying gear hitherto used.

THE Cambridge University Press has in preparation, for appearance in its Cambridge Technical Series, "Architectural Building Construction," W. R. Jaggard and F. E. Drury, vols. ii. and iii.; "Electrical Engineering," Dr. T. C. Baillie, vol. ii.; "Automobile Engineering," A Graham Clarke; "Electrotechnical Measurements," A. E. Moore and F. Shaw; "Paper: Its Uses and Testing," S. Leicester; "Mining Geology," Prof. G. Knox and S. Ratcliffe-Ellis; "Textile Calculations—Materials, Yarns, and Fabrics," A. M. Bell; "Laboratory Note-book for Applied Mechanics and Heat Engines," F. Boulden; "Elements of Applied Optics," W. R. Bower; "Electric Installations," C. W. Hill; "Accounting," J. B. Wardhaugh; "Chemistry for Textile Students," B. North and N. Bland; "Dyeing and Cleaning," F. W. Walker; and "Experimental Building Science," J. L. Manson, vol. ii.

OUR ASTRONOMICAL COLUMN.

THE PLANET MERCURY.—This planet will be favourably visible as a morning star at the end of the present year and the first week of January. On December 31 it will rise at 6h. 18m. a.m., or 1h. 50m. before the sun, and this interval will undergo little change on the few following mornings. The greatest elongation will occur on the morning of January 8 (23° 13′ W.). The planet will be situated in Ophiuchus, and at the period from December 26 to 29 will be placed about $4\frac{1}{2}°$ south of the star η Ophiuchi (mag. $2\frac{1}{2}$). With a clear sky in the region of the S.E. horizon it will be possible to observe Mercury with the naked eye on the mornings from about Christmas Day to January 10. The planet's stellar magnitude on January 1 will be +0·2, and on January 6 ±0·0, according to the Nautical Almanac.

THE JANUARY METEORS.—This display will probably furnish a rather striking event on January 3, when there will be no moonlight to interfere with observation. Last year the meteors were unusually abundant, and presented a curious feature, the centre of radiation being about 7° north of the position determined in previous years. Formerly this was at 231°+52°, but on January 3, 1918, the point was at $234°+59\frac{1}{2}°$, which nearly corresponds with the place of the star ι Draconis. The meteors move rather slowly, and they often traverse long flights, the radiant being low in altitude, and only 14° above the horizon in due north at 8.40 p.m. if the point is in N. decl. 52°. The shower will probably be presented to the best effect in the morning hours of January 3, but observations should also be conducted in the early evening hours of January 2. It will be important to determine the place of radiation as accurately as possible.

OPPOSITION OF VESTA.—Vesta will be in opposition on January 16, magnitude 6·9. The following ephemeris is from the Berlin Rechen-Institut:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
January 5	8 4 6	22 14	0·400	
13	7 55 48	23 3		0·183
21	7 47 0	23 49		0·182
29	7 38 36	24 31		0·186
February 6	7 31 6	25 6		0·195
14	7 25 12	25 33	0·395	

DISTRIBUTION OF LUMINOSITY IN STAR CLUSTERS.—An interesting summary of some recent work by Prof. E. Hertzsprung on the distribution of luminosity in globular clusters is given in the *Observatory* for December. In view of the immense distances of these objects, it is probable that a multitude of faint stars belonging to them leave no impression on the photographs, although they must contribute appreciably to the general luminosity of the cluster. In the case of M3, by giving a long exposure with the stars somewhat out of focus, Prof. Hertzsprung obtained an image with a continuous distribution of photographic density, which permitted measurements of the total amount of light given by different parts of the cluster. The luminosity due to the stars which appear in the ordinary photographs was then subtracted, and the remainder represented the light of the faint stars. The distribution of these faint stars was thus found to follow closely that of the bright ones. The total photographic light of the cluster was equivalent to mag. 7·17, and half of this was from the space within a radius of 50″. If the distance of the cluster be 10,000 parsecs, half the stars lie within a radius of $2\frac{1}{2}$ parsecs, indicating a remarkable concentration towards the centre. The light-intensity in unit volume would, in fact, be 10^5 times higher than that in the neighbourhood of the sun.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES FOR 1918.

Mathematics.—Grand prize of the mathematical sciences to Gaston Julia, Samuel Lattès receives a very honourable mention; the Poncelet prize to Sir Joseph Larmor, for the whole of his mathematical work; the Francœur prize to Paul Montel.

Mechanics.—The Montyon prize to Ch. Boileau, for his studies on petrol motors; the Boileau prize to MM. C. Camichel, D. Eydoux, and M. Gariel, for their experiments and calculations on hammering in water-mains; Henri de Parville prize to Emile Belot, for his scientific and industrial work. No memoir was received on the subject proposed for the Fourneyron prize.

Astronomy.—The Lalande prize to Aristarch Belopolsky, for his work on spectrum analysis applied to astronomy; the Valz prize to Frédéric Sy, for his astronomical work as a whole; the Janssen prize to P. Stanislas Chevalier, for his astronomical work in China. The Damoiseau and Pierre Guzman prizes are not awarded.

Geography.—The Tchihatchef prize to Filippo de Filippi, for his contributions to the geography of the Kara-Korum range and of Central Asia. The Delalande-Guérineau, Gay, and Binoux prizes are not awarded.

Navigation.—The prize of 6000 francs between Ernest Berger and Emile Guilbert (3000 francs) and Georges Walser and André Broca (3000 francs), for work which cannot at present be disclosed; the Plumey prize divided equally between Maurice de Broglie and C. J. Tossizza, for work bearing on the national defence.

Physics.—The L. La Caze prize to Aimé Cotton, for his researches in magneto-optics; the Hébert prize to P. Boucherot, for his work in electricity; the Hughes prize to Anatole Leduc, for the whole of his work; the Danton foundation to Louis Dunoyer, for his works on radiant phenomena; the Clément Félix prize to Paul Langevin, for his work on electrical resonance.

Chemistry.—A Montyon prize (unhealthy trades) to Henri Guillemard and André Labat (2500 francs), for their work relating to collective protection against asphyxiating gases; an honourable mention (1500 francs) to Félix Leprince-Ringuet, for his researches on the inflammability of methane, and to Louis Nomblot (1000 francs), for a method of preparation of a dangerous product utilised by artillery; the Jecker prize to Robert Lespieau, for his work as a whole; L. La Caze prize to Paul Lebeau, for his chemical researches, mainly in inorganic chemistry; the Cahours foundation divided between Mme. Pauline Ramart-Lucas (2000 francs) and Etienne Boismenu (1000 francs); the Houzeau prize to Marcel Guichard, for his researches on iodine and molybdenum compounds.

Mineralogy and Geology.—The Cuvier prize to Arthur Smith Woodward, for his work on fossil vertebrates.

Botany.—The Desmazières prize to Camille Sauvageau, for his researches on the biology of the Algæ; the Montagne prize to Joseph Capus, for his researches in plant pathology, with an honourable mention to Amédée Laronde for his contributions to cryptogamic geography; the de Coincy prize to Jules Laurent, for his work on the flora and botanical geography of the neighbourhood of Reims.

Anatomy and Zoology.—The Thore prize to Pierre Chrétien, for his researches on the Lepidoptera. The da Gama Machado and Savigny prizes are not awarded.

Medicine and Surgery.—Montyon prizes to Félix Lagrange (2500 francs), L. Ombredanne and R. Ledoux-Lebard (2500 francs), A. Mignon, Henry Billet, and Henri Martin (2500 francs); mentions to André and Joseph Chalier (1500 francs), Alfred Khoury (1500 francs), and E. Velter (1500 francs); a citation to Henri Velu; the Barbier prize to L. Bruntz and Marcel Jaloux, for their memoir on medicinal plants; the Bréant prize (arrears of interest) between Jean Pignot (2000 francs), Maurice Lœper (1500 francs), and Julien Dumas (1000 francs). The Bellion prize is not awarded, but encouragements (500 francs each) are accorded to Josefa Ioteyko, for her researches on fatigue and muscular work; to R. Legendre, for his contributions to the treatment of carbon monoxide poisoning, artificial respiration, and studies on bread manufacture; and to B. Roussy, for his book on the domestic education of women. The Baron Larrey prize is not awarded, but A. Rochaix receives a recompense (500 francs) for his studies on the rapid detection of sewage contamination in drinking-water. No awards were made of the Mège and Godard prizes.

Physiology.—The Montyon prize to Stéphen Chauvet, for his memoir on infantilism; the Lallemand prize to Henry Cardot and Henri Laugier, for their work on the electrical stimulation of nerves; the L. La Caze prize to Raphaël Dubois, for the whole of his work in physiology; the Pourat prize, no memoir on the subject proposed has been received; the Martin-Damourette prize to Gérard de Parrel, for his work entitled "Précis d'anacousie vocale et de labiologie"; the Philipeaux prize to Hugues Clément, for his studies on the application of the centrifuge in producing alterations in the development of the egg and embryo in several animals; the Fanny Emden prize is not awarded, but the arrears are attributed to Mme. Albert Dastre.

Statistics.—The Montyon prize is not awarded.

History and Philosophy of the Sciences.—The Binoux prize to Maurice Delacre, for his memoir on the history of chemistry.

Medals.—Berthelot medals are awarded to André Labat and to Marcel Guichard.

General Prizes.—The Bordin prize, no memoirs received dealing with the subject proposed; the Estrade Delcros, Le Conte, Parkin, and Wilde prizes are not awarded; the Houllevigue prize to the late Camille Tissot, for the whole of his work; the Saintour prize to René Kœhler, for his work in zoology; the Henri de Parville prize between R. Devillers (1500 francs), for his book on the dynamics of the aeroplane, and Hector Pécheux (1000 francs), for his book on metallurgy; the Lonchampt prize to Emile Guyénot, for his studies on the growth of organisms under aseptic conditions; the Caméré prize to Paul Séjourné, for his engineering work; the Victor Raulin prize to Jules Rouch, for his work in meteorology, atmospheric electricity, and physical oceanography; the Gustave Roux prize to the late Georges Boyer, for his geological work; the Thorlet prize to Adolphe Richard.

Special Foundations.—The Lannelongue foundation to Mmes. Cusco and Ruck; the Laplace prize to Jean Vignal; the L. E. Rivot prize to Jean Vignal (750 francs), Paul Reufflet (500 francs), Henri Scaillierez (750 francs), and Camille André Antoine (500 francs).

Foundations for Scientific Research.—The Trémont foundation (1000 francs) to Charles Frémont, for his researches relating to the working of metals; the Gegner foundation between F. Pisani (2000 francs), for his work in mineralogical chemistry, and the late Samuel Lattès, for his work on mathematical analysis; the Jérôme Ponti foundation between Paul Barbarin (2000 francs), for his work on non-Euclidean geometry, and Louis Fabry (1500 francs), for his work on the smaller planets; the Henri Becquerel foundation between Camille Gutton (2000 francs), for his work in physics, especially that having reference to the national defence; Pierre Fatou, 2000 francs.

The Bonaparte Foundation.—Twenty-one requests for grants have been considered, and the following six are recommended:—2000 francs to E. de Boury, to allow him to continue his studies of the gasteropod molluscs; 3000 francs to Auguste Chevalier, for his studies on the forest flora of Indo-China, and for his researches on the woods of that region capable of being utilised; 2000 francs to Paul Garrigou-Lagrange, for the continuation of his meteorological studies and attempts at the kinematography of the atmospheric movements; 2000 francs to Louis Germain, for the publication of his works on the malacological fauna of Africa and Asia, and for the continuation of his study of the molluscs of the Loire basin and the French coast of the Atlantic Ocean; 2500 francs to C. Le Morvain for completing the publication of the "Carte photographique et systématique de la lune"; 5000 francs to H. Perrier de la Bathie, for the continuation of the geological and botanical researches which he has pursued with success at Madagascar for many years. The balance of the fund in hand, after paying the above grants, amounts to 72,500 francs.

The Loutreuil Foundation.—4000 francs to R. Anthony, for printing the osteological catalogue of the collections of the National Museum of Natural History; 5000 francs to Charles Moureu, for completing the equipment and collections of the laboratory of the Collège de France; 5500 francs to the Lyons National Veterinary School, for the installation of a kinematograph for teaching purposes; 3000 francs to the Toulouse National Veterinary School, to complete the radiological installation for the diagnosis of diseases of animals; 4000 francs to Edouard Sauvage, for the construction of an apparatus designed to study the forces of inertia in the parts of a machine; 1000 francs to E. Ariès, for the purchase of a calculating machine for use in his researches on the equation of state of fluids; 2000 francs to Henry Bourget, for assisting the publication of the *Journal des Observateurs*; 2000 francs to Maurice Cossmann, for his various publications on palæontology; 2000 francs to A. Ménégaux, for the French ornithological review; 6000 francs to Aloys Verschaffel, for the calculation and publication of the ephemerides of the minor planets, according to a plan approved by the Bureau des Longitudes; 5000 francs to Col. Roche, for the equipment of the laboratory of the Ecole Supérieure d'Aéronautique.

Charles Bouchard Foundation.—2000 francs to Jean Nageotte and Louis Sencert, for researches on grafting with dead tissues; 1500 francs to Paul Brodin and François Saint-Girons, for their work on bleeding; 1500 francs to Pierre Duval and Adrien Grigaut, for their researches on traumatic shock.

A NEW THEORY OF THE ICE AGE.

TWO recent papers in the Quarterly Journal of the Royal Meteorological Society by Mr. C. E. P. Brooks have emphasised the point of view that there is no necessity to appeal to astronomy or to make any arbitrary assumptions, such as that of a specially cold region in space, in order to account for an Ice age. The subject of the papers is "Continentality and Temperature" (Quart. Journ. Roy. Met. Soc., vol. xliii., pp. 159–73, and vol. xliv., pp. 253–70), and the author's endeavour is to correlate mean temperature at certain stations with the distribution of land and water in the neighbourhood of the stations, first for a definite region, including the Baltic and most of northern Europe, without much range of latitude, and next for the world in general, with special reference to latitude.

It is clear that very definite results are unlikely, having regard to the very irregular distribution of land and its topographical peculiarities; and not less clear that a great deal of labour must have been involved in obtaining any result whatever. The temperature of a place is affected by the size, distance, and direction of land and water masses in relation to the prevailing winds, and also by the relief of the land and the temperature of the neighbouring sea. The correction for height above sea-level is apparently straightforward and simple, but in regard to the others it was only convenient to take as a first approximation the percentage of land included in circles of 5°, 10°, and 20° radius, centred at the station in question, and the resulting correlations are by no means easy of interpretation.

Certain stations introduce special difficulties, *e.g.* Haparanda, where the continentality is not the same throughout the year owing to the freezing of the sea in winter. There are, however, some general conclusions worth quoting:—(1) In winter the effect of land to the west is to lower temperature. (2) In winter the effect of land to the east is almost negligible, so that even in continental areas the lowest temperatures are found near the eastern coasts. (3) The general effect of land in the summer either east or west is to raise temperature, but not to anything like the same extent as the opposite effect in winter.

Special interest attaches to the extension of the investigation with regard to long intervals of time. In the Litorina (early Neolithic) period the climate of the Baltic regions was rather different, as also were the distribution of land and the freedom of access from the Atlantic. In the first paper, which deals specially with this region, the author claims that the alterations of continentality suffice to account for all the historic variations of local temperature. A more important generalisation follows in the second paper, in which the author considers the period immediately preceding the last or Quaternary glacial period. An outline is given of the distribution of land at that period, and an explanation of the formation of ice-sheets by reason of fall of temperature and increase of snowfall, the argument being almost entirely meteorological. The next step, however, is of a different kind, and the theory of isostasy is summoned to account for the gradual upsetting of an apparently permanent glaciation. The weight of the masses of ice causes the subsidence by slow degrees of the ground below equilibrium being gradually restored by the fluid interior. The sinking of the ice-surface causes an increase of temperature with consequent melting. The isostatic action is, however, so slow that the surface continues to sink, causing a higher temperature in higher latitudes (inter-glacial period). After a time the equilibrium, which is clearly disturbed in the opposite direction, induces isostatic action again, raising the land-surface and causing another glaciation. The author considers that this "ebb and flow" has taken place four times in succession, the amplitude diminishing each time, as is to be expected.

The course of these age-long changes is not quite so simple as its general outline, for many irregularities are necessarily introduced by the disposal of the melting ice, which will depend on the geographical features thus uncovered, and, again, by the locking up of so much moisture into glaciers; but the explanation of such well-known phenomena as the warm period of the Tertiary by this geographical method appears more straightforward than any depending on assumptions as to the effect of changes in the obliquity of the ecliptic—an effect which we are almost powerless to forecast.

The purely meteorological part of the subject is not without difficulties of its own, some very anomalous figures for sea temperature in high latitudes resulting from the attempt to deal with the earth as a whole, and to allow for the vagaries of land distribution and of ocean currents. The effect of insolation in different latitudes and on different land and water surfaces is a very difficult problem, and so also is the question of precipitation, but Mr. Brooks is not afraid to tackle these difficulties, and must have brought an enormous amount of research to bear, in addition to the very laborious and complicated analysis of the data obtained. It is to be hoped that this subject will not escape the notice of the British Association Geophysical Committee. W. W. B.

REPORT OF THE DEVELOPMENT COMMISSIONERS.

THE report of the Development Commissioners for the year ended March 31, 1918, has been published as a Parliamentary Paper (118, price 3*d.* net), extracts from which are subjoined. Except so far as the special circumstances of the war have called for extended expenditure or new schemes in respect of food supply and natural products, or for the preliminary outlay in the preparation of schemes which may employ labour after the war, the Commissioners have continued the policy which they have adopted since the commencement of the war of confining their advances in the main to ensure the continuity of schemes which were already in working in 1914, and cannot properly be discontinued. In one instance, that of flax-growing, the expansion owing to war needs has led to an increase of the undertaking to a scale on which it is no longer of an experimental or educational nature, such as is appropriate for assistance from the Development Fund, and the undertaking has accordingly been taken over by the Board of Agriculture.

In the introduction to last year's report mention was made of an advance of 50,000*l.* for improving the fish food supply by installing motors in fishing-boats. But the problems of this supply are not solved by the mere catching of fish; there remain the problems of its rapid delivery or preservation. In connection with these latter points the Commissioners have recommended an advance of 6750*l.* in aid of landing and entraining facilities at Valentia, and in January, 1918, they promised to recommend an advance (later fixed at 10,000*l.*) for the establishment of an experimental fish-canning factory on scientific lines.

Reference was also made last year to the extra expenditure on a largely increased supply of plants for afforestation, and this has continued in the year now under review. Thus an advance of 6905*l.* to the Commissioners of Woods for this purpose has been recommended; while in Scotland, in addition to ordinary expenditure, grants of 2000*l.* for each of the financial years, 1917–18 and 1918–19, were recommended to meet expenditure on the establishment of forest nurseries, and 930*l.* for an additional Forest Officer on the staff of the Board of Agriculture. A sum of 1000*l.* was also made available for preliminary arrangements for the afforestation of privately owned lands and a flying survey.

In earlier reports the Commissioners have explained in some detail the important scheme financed from the Development Fund for the development of agricultural research at universities, colleges, etc., and the extension of advisory and local investigation work. The scheme includes provision for the encouragement of individual workers in agricultural science outside the field covered by the research institutes, and the Commissioners have annually recommended a grant not exceeding 3000*l.* for this kind of work in England and Wales, and small grants for work in Scotland. The Commissioners originally contemplated a maximum grant of 5000*l.* for the whole United Kingdom, to be allocated on the advice of a Committee representing Scotland and Ireland, as well as England and Wales, and suggested that the English Board's Advisory Committee on agricultural science might be enlarged for this purpose by the addition of representatives nominated by the Agricultural Departments for Scotland and Ireland. An agreement has now been reached under which the three Agricultural Departments will co-operate for this purpose. The English Board's Advisory Committee has been dissolved and the Commissioners have set up a Committee of their own, including representatives of the three Departments, to report to them on applications for "Special Research" grants, and on such other subjects as the Commissioners may refer to them. The Commissioners are prepared to consider, and, if they are satisfied with the applications supported by the new Committee, to recommend, an annual grant, not exceeding 5000*l.*, for the assistance of special research schemes in the United Kingdom. The Advisory Committee is constituted as follows:—Sir Daniel Hall, K.C.B., F.R.S. (chairman), Mr. W. Bateson, F.R.S., Prof. Biffen, F.R.S., Mr. J. R. Campbell, Dr. R. B. Greig, Mr. W. B. Hardy, F.R.S., Sir T. H. Middleton, K.B.E., C.B., Prof. Noel Paton, F.R.S., Sir David Prain, F.R.S., Dr. G. H. Pethybridge, Dr. E. J. Russell, F.R.S., and Dr. David Wilson.

The grants recommended for research purposes are as follows:—

Agriculture and Rural Industries.

	Grants £
Aberdeen University and North of Scotland College of Agriculture—Joint Committee of:	
Schemes of agricultural research ...	813
Board of Agriculture and Fisheries:	
Agricultural research, advisory work, etc.	31,200
Research in plant pathology at Kew, maintenance grant	1,411
Maintenance of Board's veterinary research laboratory	2,000
Agricultural and dairy education ...	13,350
Migratory and co-operative cheese schools	3,000
Scheme for augmenting the production of eggs and poultry	1,700
Board of Agriculture for Scotland:	
Schemes of special research in agricultural science	395
Extension work at the Scottish agricultural colleges	5,000
Chester Corporation:	
Investigation into the practicability of using the water-power of the River Dee, above Chester, to generate electricity for agricultural purposes	200
Department of Agriculture and Technical Instruction for Ireland:	
Special laboratory for the manufacture of anti-swine fever serum	2,500 [1]
Technical and advisory work in agriculture	4,000
Maintenance of property acquired for a veterinary research laboratory ...	196
Imperial College of Science and Technology:	
Investigation into the effect of electrical discharge on the growth of crops	595

Forestry.

	Grants £
Board of Agriculture and Fisheries:	
Forestry research, advisory work, etc.	5,000

Fisheries.

	Grants £
Board of Agriculture and Fisheries:	
Grants to various institutions for fishery research	410

SUMMARY OF RECOMMENDATIONS MADE DURING THE YEAR 1917–18.

	Grants £	Loans £
Agriculture and rural industries	153,665	5,125
Forestry	21,652	—
Reclamation and drainage of land	750	—
Harbours	8,093	350
Fisheries	2,162	—
	186,322	5,475
Total ...	191,797	

SUM TOTAL OF ADVANCES RECOMMENDED TO THE TREASURY UP TO MARCH 31, 1918.

	Grants £	Loans £
Agriculture and rural industries	1,645,837	133,625
Forestry	123,485	153,411
Reclamation and drainage of land	7,315	4,000
Rural transport ...	—	80,000
Harbours	222,632	171,760
Inland navigations ...	—	109,500
Fisheries	111,459	30,250
Sea defence works ...	—	800
	2,110,728	683,346
Total ...	2,794,074	

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Senate on December 18 adopted a resolution approving the appointment of Prof. H. G. Atkins as assistant principal of King's College for five years as from January 1, 1919.

The annual report of the University Extension Board shows that, although four years of war have considerably reduced the number of students, there were still between five and six thousand in attendance at the courses last year, the number of those who qualified for certificates being as high as in the previous twelve months. The study of foreign nationalities and of problems of reconstruction were

[1] Part of sum of 8000*l.* sanctioned in December, 1914, for capital cost of a Veterinary Research Laboratory.

notable features of the year's activities. Important pioneer work was done, both in England and overseas, through the Y.M.C.A. Universities' Committee, and in conjunction with the Victoria League lectures were also organised at military hospitals. Amongst the fresh developments during the session were the institution of a diploma for civic workers under the scheme for diplomas in the humanities, and the inauguration of lectures in offices of the Ministry of Munitions, this being probably the first occasion on which the University has been invited to carry on educational work in a Government office.

The Senate is taking steps to provide that students from overseas universities of the Empire who have served in his Majesty's Forces may be admitted to certain Intermediate and Final Examinations, and that reports may be furnished with the view of enabling the universities at which the students have begun their respective courses to recognise these examinations of the University of London in lieu of their own. By this arrangement it is hoped that a number of students may continue a university career while they are waiting until they can return to their own countries.

The Senate has conferred on Dr. H. Stanley Allen, of King's College, the title of reader in physics in the University.

DR. OTTO TUNMANN, of Berne, has been appointed professor of pharmacognosy in the University of Vienna in succession to Prof. Moeller.

MR. W. W. MYDDLETON has been appointed lecturer and demonstrator in chemistry at the Municipal Technical Institute, Belfast, in succession to Mr. C. W. Addy, who has left to take up work in chemistry in connection with the British Cellulose and Chemical Manufacturing Co., Ltd.

THE movement for adopting Latin as the universal language of the future—or, rather, of restoring it to the position which it once occupied as the language of the learned world—forms the subject of a note by Prof. Carlo Pascal in the *Rendiconti del R. Istituto Lombardo* (2) l., 14–15. It is suggested that action should be initiated by the institution in question. In support of this argument it is pointed out that the growth of scientific literature published in a multiplicity of small languages is of recent origin, and that the attempts to invent artificial languages have increased, rather than removed, the confusion. Prof. Pascal refutes the idea that Latin is a dead language, seeing that it is taught in all schools and colleges, and further points out that modern scientific terminology is largely Latinised in form. The main objection which can be raised against the proposal in its unmodified form is the grammatical difficulty. It might be quite easy for a classical scholar to write to a business manager in ancient Latin, but it would be unfortunate if the latter in his reply was so puzzled as to whether to use the dative or the accusative case of a noun that he forgot what he was writing about. A few years ago there was formed an Academia pro Interlingua, which proposed to retain the Latin vocabulary with a simplified grammar, and Prof. G. Peano, of Turin, took a leading part in this movement.

IN the presence of a brilliant company assembled at the Sorbonne, the degree of doctor, *honoris causa*, was conferred upon President Wilson by the University of Paris on December 21. In the course of his acknowledgment of the honour, the *Times* reports President Wilson to have said:—"I have always thought that the chief object of education was to awaken the spirit, and that, inasmuch as literature, whenever it touched its great and higher notes, was an expression of the spirit of mankind, the best induction into education was to feel the pulses of humanity which had beaten from age to age through the utterances of men who had penetrated to the secrets of the human spirit. And I agree with the intimation which has been conveyed to-day, that the terrible war through which we have just passed has not been only a war between nations, but that it has been also a war between systems of culture; the one system the aggressive system, using science without conscience, stripping learning of its moral restraints, and using every faculty of the human mind to do wrong to the whole race; the other system reminiscent of the high traditions of men, reminiscent of all those struggles, some of them obscure, but others clearly revealed to the historian, of men of indomitable spirit everywhere struggling towards the right, and seeking, above all things else, to be free. . . . I feel that this war is intimately related with the university spirit. The university spirit is intolerant of all the things that put the human mind under restraint. It is intolerant of everything that seeks to retard the advancement of ideals, the acceptance of the truth, the purification of life; and every university man can ally himself with the forces of the present time with the feeling that now at last the spirit of truth, the spirit to which universities have devoted themselves, has prevailed and is triumphant."

WE have received from the Asiatic Society of Bengal a Catalogue of the Scientific Serial Publications in the Principal Libraries of Calcutta. In this catalogue there are several interesting features to be noted. Full information is given, in regard to the twenty-four libraries indexed, as to where they are to be found and the hours when they are open. In the case of libraries that are not open to the public the reader is told how to get permission to consult the books. The arrangement of the catalogue is geographical, the world being divided into twenty-four countries subdivided into towns placed in alphabetical sequence. Publications issued by an institution are indexed under the name of the town in which the institution is established. Independent serials are indexed under the town in which they are published. In each case there is indication of the library or libraries in which the publication may be found. It may happen that, although the title of a journal is well known, a reader may be unable to recollect the name of the town in which it is published. To meet this difficulty an alphabetical index of names of journals with references to their position in the catalogue is provided. We are glad to see that volumes or parts missing from the sets are recorded. The catalogue has been compiled by Mr. Stanley Kemp with the assistance of the librarians of the institutions concerned. Dr. W. A. K. Christie, of the Geological Survey of India, honorary secretary of the Asiatic Society of Bengal, has given Mr. Kemp continuous advice and help. The result does great credit to all who have taken part in a catalogue remarkable both for its completeness and for the care with which the material has been arranged.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 12.—Sir J. J. Thomson, president, in the chair.—L. **Hill** and H. **Ash**: The cooling and evaporative powers of the atmosphere, as determined by the kata-thermometer. A further investigation has been made of the cooling power of air at known temperature and velocity of movement in the large wind-tunnels at the East London College, with the aid of Mr. N. A. V. Piercey, the lecturer on aeronautical engineering, timing the rate of cooling of the kata-thermometer, a large-bulbed spirit thermometer graduated between 100° and 95° F., and the factor of which was determined whereby the cooling power on a surface at body temperature is expressed in millicalories per sq. cm. per sec. The formula was deduced $H=(0\cdot27+0\cdot49\sqrt{v})\theta$, where θ=the difference between the temperature of the air and 36·5° C. Using this formula, the authors found the velocity of the wind determined by the kata-thermometer at Kew Observatory agreed closely with the velocity determined by the Cup and Dines anemometers. Using this formula to determine velocity, the cooling of the wet kata-thermometer was reinvestigated in a tube 3 in. in diameter, through which air was drawn from a chamber, the temperature and humidity of which could be varied. The effect on evaporative power of varying the temperature of the evaporating surface was determined, and the use of the kata-thermometer as a measure of evaporative power of drying processes pointed out. The effect of barometric pressure on cooling power was worked out in a chamber in which the atmospheric pressure was varied from +15 lb. to 340 mm. Hg. The formula determined expresses influence of barometric pressure on convection cooling power. At ordinary temperatures cooling power exerted on dry kata-thermometer is half due to radiation, half to convection.—H. C. **Bazett**: Observations on changes in the blood-pressure and blood-volume following operations in man.—Dr. Marie C. **Stopes**: The four visible ingredients in banded bituminous coal. The coal discussed is the ordinary streaky bituminous coal of the British Coal Measures widely used in house and factory. Disregarding for the time the ultimate morphological nature of the plant organs contributing to them, four differing substances or constituents are described as composing such coal. These can be recognised by differences in their general character. (*a*) Differences in their macroscopic appearance and texture (*i.e.* with the naked eye in hand specimens). (*b*) By their different behaviour when treated with various chemicals. (*c*) By the differences in the *débris* of each which result from their treatment with various chemicals. (*d*) By the differences in microscopic sections of untreated samples of each. These differences are further followed up by analyses and distillations to be considered in a later paper. Diagrams are given to show the characteristic distribution of these constituents in section, and to indicate, if not a parallel to, at least a possibly useful comparison with, petrological work on rocks. The four ingredients thus determined are fusain (the already widely discussed "mineral charcoal"), and durain, clarain, and vitrain, the three latter names being given now for the first time. —Sir W. **Crookes**: The arc spectrum of scandium.

Royal Meteorological Society, December 18.—Sir Napier Shaw, president, in the chair.—Capt. C. J. P. **Cave**: A cloud phenomenon. On April 15, 1915, a cloud with an approximately straight front was seen approaching South Farnborough from the north-west. The sky had been clear in the morning. The cloud came overhead at 9.33 a.m., after which the sky was overcast; the sunshine record ended abruptly. At all stations in the eastern and south-eastern counties the sunshine record was similar, though the times of cessation differed considerably. By comparing the records it was possible to draw lines on a map showing the times when the cloud-front was approximately overhead. The 9 a.m. line ran through the Isle of Wight to Southampton, through Hampshire, Berkshire, and Middlesex, north-west of London, along the western borders of Suffolk and Essex, through Norfolk to Cromer. At 10 a.m. the cloud-front ran over the east end of the Isle of Wight, along the eastern border of Hampshire, through Surrey, south-east of London, through Essex, Suffolk, and Norfolk to the sea some miles north of Yarmouth. At 2 p.m. the cloud-front ran from between Pevensey and Bexhill to Westgate. A map shows the travel of the cloud-front from 7 a.m. to 3 p.m., and indicates that the cloud travelled across the country at about twelve miles per hour.—C. E. P. **Brooks**: Notes on a meteorological journal at Wei-hai-wei kept by Commander A. E. House, 1910 to 1916. Wei-hai-wei is a small British concession in the north of China, and is important as being in a sense the sanatorium of British stations in the North Pacific. It has a cool summer with a moderate rainfall, and a dry, bracing winter. Meteorological observations were taken by Commander House four times daily, and include pressure, temperature, humidity, rainfall, wind, and weather. These have been summarised and discussed, with notes on the relation of the various elements to wind direction and on the general climatology and possibilities of Wei-hai-wei.—Capt. E. H. **Chapman**: The annual symmetrical variation of certain elements, with a note on the choice of seasons. The average lengths of the astronomical day for the calendar months are more symmetrical for the calendar year January to December than for a year (1) December to November or (2) February to January. The mean monthly temperatures, Midland Counties, are most symmetrical for a year February to January. The mean monthly values of various meteorological elements are symmetrical for the calendar year January to December. Mean weekly temperatures, Midland Counties, are symmetrical for a year commencing with the fifth week of one year and ending with the fourth week of the following year. The method used for showing annual symmetry is to draw the first half of the curve forwards and the second half of the curve backwards along the ordinates of the first half, the nearness of the two portions of the curve showing the degree of symmetry. Annual symmetrical variation makes the division of the year into seasons a difficult matter. There is evidence in favour of making March a winter month. The usual meteorological three-monthly seasons are too early in the year, while the astronomical seasons are too late. An alternative suggestion of the three-monthly seasons, middle of December to middle of March, etc., is put forward.

SHEFFIELD.

Society of Glass Technology, December 18.—Mr. W. F. J. Wood, president, in the chair.—S. **English**: An apparatus for the accurate calibration of burette tubes. The method employed for the burette is based on that for the pipette, since it involves the use of a standardised pipette of precisely known volume and time of drainage. Mercury, however, is used instead of water to fill the burette and the standard pipette into which it drains in order to calibrate it; under the same conditions of ordinary use water is placed above the mercury level in the burette. This meniscus is viewed through a telescope attached to a cathetometer, and by an ingenious arrangement a needle is made to produce a mark on the burette precisely at the level of the meniscus. The author stated that a burette could be calibrated in five minutes, and the accuracy was far greater than was usually observed in calibrating these instruments.—Dr **Turner**: Bottle-glass and glass-bottle manufacture. The author's remarks were confined largely to two points—quality and quantity—in glass-bottle production. In regard to quality he pointed out that it was useless to produce a bottle if the glass of which it was made was unsuitable for contact with the material it was intended to hold. Medical bottles in particular should be subjected to tests in order to ascertain that they conformed to a certain standard. One test was suggested in which solutions of the alkaloids and mercury solutions were kept in contact with the bottle for twenty-four hours and the absence or production of a sediment noted. The results of heating a number of different types of bottle in contact with water and steam under pressure were also described and tabulated, and emphasis was laid on the necessity for avoiding excessive use of soda-ash in melts. In the case of bottles made from sand, soda-ash, and lime spar, it was pointed out that lime spar should not fall below 7 to 8 per cent. of the batch mixture, otherwise the glass was acted on by water to a marked extent. The author also dealt with the problem of workability, whether from the point of view of hand-working or machine-working. The effect of different constituents present in bottle-glass, such as silica, soda-ash, lime, magnesia, and alumina, was described, and the importance of arranging a batch so that the resulting glass should set quickly was emphasised, if production at a rapid rate was desired. The limits of workability for glasses containing sand and soda, with lime, magnesia, or alumina, were set out.

DUBLIN.

Royal Dublin Society, November 19.—Dr. G. H. Pethybridge in the chair.—Dr. G. H. **Pethybridge** and H. A. **Lafferty**: A disease of tomato and other plants caused by a new species of Phytophthora. The disease is one in which the root system and base of the stem of young plants become involved in a rot leading to the death of the plants. It is caused by a species of Phytophthora hitherto undescribed, having sexual organs (with amphigynal antheridia) similar to those first described for *P. erythroseptica*. The disease is contracted from the soil, and also occurs naturally in Petunias. The fungus was proved to be parasitic also towards Aster, Gilia, Cheiranthus, *Solanum tuberosum*, Fagus, etc., and it is extremely probable that it occurs naturally and causes disease in some of these plants. Owing to the facility with which the tomato produces adventitious roots, affected plants can not infrequently be "cured" by amputating the diseased parts and treating the still healthy portions as cuttings. The disease causes serious losses in nurseries, but can be avoided by raising seedlings in steam-sterilised compost.—E. J. **Sheehy**: Part i., An economical method of determining the average percentage of fat in a cow's milk for a lactation period. An account of two experiments conducted at the Albert Agricultural College. The author explains the liability to error in determining the average percentage of fat in a cow's milk by the method of averaging two or three random samples taken during the lactation period, because of the great variability in fat yields for successive days. A test is suggested over four consecutive days as suitable and convenient, and this single test is applied to the fifth month of the lactation period as a means of determining the average percentage for the whole period. Part ii., The comparative variation in the different constituents of cow's milk. In this part an analysis is made of the variability of milk, and it is shown by graphical representation that the solids not fat and water in the milk of successive days vary approximately as the milk, while fat varies in a fashion peculiar to itself, suggesting that the secretion of fat is governed by factors not identical with those governing the secretion of the other constituents.

BOOKS RECEIVED.

Catalogue of the Scientific Serial Publications in the Principal Libraries of Calcutta. Compiled for the Asiatic Society of Bengal by S. Kemp. Pp. xii+292. (Calcutta: Asiatic Society of Bengal.)

The Cambridge University Calendar for the Year 1918–19. Pp. xxvi+1074. (Cambridge: At the University Press.) 10s. 6d. net.

Who Giveth Us the Victory. By A. Mee. Pp. 191. (London: George Allen and Unwin, Ltd.) 5s. net.

Echo Personalities. By F. Watts. Pp. 111. (London: George Allen and Unwin, Ltd.) 4s. 6d. net.

Ambulance de "l'Océan," La Panne. Tome ii. Fasc. i. Pp. 376. (Paris: Masson et Cie.) 18 francs net.

Everyman's Chemistry. By E. Hendrick. Pp. x+319. (London: University of London Press, Ltd.) 8s. 6d. net.

Coniferous Trees for Profit and Ornament. By A. D. Webster. Pp. xx+298. (London: Constable and Co., Ltd.) 21s. net.

The Scientist's Reference Book and Diary, 1919. (Manchester: J. Woolley, Sons, and Co., Ltd.)

The Production and Treatment of Vegetable Oils. By T. W. Chalmers. Pp. x+152+9 folding plates. (London: Constable and Co., Ltd.) 21s. net.

Agricultural Bacteriology. By Prof. H. W. Conn. Third edition, revised by H. J. Conn. Pp. x+357. (Philadelphia: P. Blakiston's Son and Co.) 2 dollars net.

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

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THURSDAY, JANUARY 2, 1919.

INTERNATIONAL ORGANISATION OF SCIENCE.

THE formation of a considerable number of international organisations for the promotion of scientific observation and research is the result of the recognition of the fact that international co-operation is highly desirable in all directions, and is even indispensable in many cases.

A memorandum prepared by the Royal Society early in 1918 gives a list of about seventy-five such associations of scientific workers, and there are many more. The Royal Society list is divided into five groups, which include such subjects as standards of weight and measure, atomic weights and physico-chemical constants, problems in geodesy, seismology, meteorology, and exploration of the sea, the chart of the heavens, an international chart of the world, and the cataloguing of scientific literature. Eighteen congresses which meet periodically are concerned with various departments of pure and applied science, from mathematics to medical radiology, while the International Association of Academies aims at unifying international work and the avoidance of duplication. There are many other associations, some of which have been long in operation, while others have been called into existence by modern developments, as, for instance, in relation to aviation.

Since the beginning of the war it has become increasingly obvious that direct communication between the Allied Powers (including the United States) and the Central European Powers was no longer possible. Neither did it seem probable that the Allies would consent to personal communication with the German peoples, even after the cessation of hostilities, until the latter had adopted an entirely new attitude towards the rest of the world. Of this change of mind and heart there is but small indication at present, and consequently the time when cordial assistance and co-operation can be mutually exchanged between the Allied Powers and the German-speaking peoples seems indefinitely postponed. The problem, then, is, What can be done with these international organisations? They must be freed from German membership and influence, and to accomplish this either the Germans must be excluded or new and independent associations must be formed by the Allies, together with such neutral Powers as, after deliberation, choose to dissociate themselves from Teutonic combinations. The latter appeared to be the only practicable course, and at the conference recently held in Paris, of which an account was given in NATURE of December 26, resolutions were carried affirming the necessity for the formation of new international associations in place of the old. These associations will provide for the development of international action in relation to all the subjects mentioned above, but leaving to diplomatic agency the merely administrative relations between public services, such as those regulating navigation, railways, telegraphs, weather reports, etc.

The representatives of science in the United States propose to go further. An executive order by President Wilson under date May 11, 1918, refers to the National Research Council which was called into existence in 1916 by the U.S.A. National Academy of Sciences, with an eye especially to national requirements in time of war. The work of this council having proved so valuable, it is now constituted on a permanent basis, with duties specified in a series of paragraphs. These duties include not merely the task of bringing into co-operation for national purposes the industrial, naval, and military agencies. The council is expected to stimulate research in every department of science, to survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilising the scientific and technical resources of the country for dealing with these projects. Needless to add, co-operation, national and international, is to be freely invoked.

At the Inter-Allied Conference held in London in October, and at the later Conference in Paris, the idea developed into the proposal not only to form a National Research Council in each country, but the meeting itself assumed provisionally the title of "The International Research Council," with an executive committee of five members and an administrative bureau to be established in London. The president of the new body is M. E. Picard, one of the permanent secretaries of the French Academy of Sciences, the other members being Prof. G. E. Hale, representing the United States; Prof. Volterra, representing the Accademia dei Lincei of Rome; Major Lecointe, representing Belgium; and Prof. Arthur Schuster, representing the Royal Society. It will be the duty of this executive committee to work out the details of the organisation to be ultimately adopted, and to submit its proposals to the various bodies concerned.

Among the subjects discussed at the conference in Paris were the proposals, already under consideration by many universities, for adding to the facilities offered to students of one nationality by teaching institutions in Allied countries. Questions relating to bibliography, the publication of abstracts of scientific memoirs, and the cataloguing of scientific papers were also considered, as well as the serious international problem relating to patent laws in different countries.

Anyone who has followed the course of events in the scientific world during the last twenty years or more will perceive that subjects of this kind have not been neglected, and that many preparatory steps have been taken, but it is also obvious that in regard to nearly all these matters we have been drifting gradually towards a chaos more and more confounded. The establishment of the system of international councils seems to be the only hope of ultimately arriving at some state of order. Readers of NATURE have been informed of the establishment in this country of the Committee of the Privy Council for Scientific and Industrial Research, and the existence of several subsidiary boards, such as those for fuel research, food investigation, and several others, with related advisory boards, as well as the National Physical Laboratory. But the co-ordination of the whole remains to be accomplished, and, so far as this country is concerned, movement in this direction is not yet in view, though it has long been urged by the British Science Guild and in these columns. The British Government is too fond of leaving things at the disposal of its permanent officials in Whitehall, who, however able they may be as officials, are in nearly all cases laymen in respect to questions involving scientific knowledge and experience. The President of the United States proceeds on a different principle in placing the whole task of organisation in the hands of the National Academy of Sciences, with power to select such representatives of the Government as are required for administrative work.

Perhaps it will be useful to add a few remarks on the subjects which are intended for investigation by these National Research Councils. Broadly speaking, there is no limit; all Nature is to be reviewed, experimented on, sounded, tested. It requires no great foresight to perceive that, on the whole, results which are expected to be immediately useful will especially be looked for by the expectant world outside. Now research may be of two kinds, one of which falls easily within the province of co-operative inquiry: the investigation of the origin, properties, and qualities of natural materials of all kinds—coal and other minerals, fibres, woods, dyes, medicinal agents, and the cultivation of medicinal plants; investigation of problems in connection with agriculture, the strength of metals, corrosion or rusting of metals and decay of all kinds of materials, such as timber, cement, and building-stone. To such inquiries may be added the accurate determination of many physical constants which are at present imperfectly known, such as melting-points, boiling-points, specific heats, or electrical conductivities, all of which may come to be very valuable, or even indispensable, in the improvements to be made in machinery and engines of all kinds.

Here are fields wide enough and full enough to occupy whole armies of workers for generations to come, and they afford examples in every direction where co-operative labour is likely to accomplish that which might defy altogether the unassisted effort of the individual worker. It is also quite possible that in the resulting enlarged and more accurate view of natural materials and resources phenomena will present themselves among which the eye of genius may perceive the way to generalisations of incalculable importance. It was the careful and accurate estimation of the densities of gases by Rayleigh which led to the discovery of the argon series of gases. It was the study of the crystalline form of the tartrates which led Pasteur by successive steps to discoveries which resulted later in the development of the entire department of science known as stereo-chemistry. For ages the fact has been known that certain substances—*e.g.* calcined oyster-shells—exhibit a feeble luminosity; but it was the systematic study of phosphorescent phenomena by Becquerel which led, in the hands of the Curies, to the discovery of radio-activity, with all its amazing consequences.

Similarly, it may be expected that research on a large scale will lead to the observation of phenomena which the international worker may not be able to interpret, but which will remain for study by the exceptionally endowed worker, who, like the poet, invokes the aid of imagination, while at the same time he has the skill, patience, and wide knowledge which enable him to derive assistance from analogous cases in departments other than his own. This kind of specialist is not to be found every day, and will not be developed even by co-operation on international lines. This is the natural genius who appears, like a Newton or a Faraday, once in a century or two. Individual freedom in fields open to research must not be controlled or impeded by schemes of organisation, nor must the public inquire too closely what is the use of this or that discovery. In course of time the study and contemplation of natural phenomena in the light of more extended knowledge will come to be acknowledged as the source of a pure joy and satisfaction to many, as art is a recognised source of happiness to others. This view of the matter should be kept sedulously in mind by every teacher.

HIGH EXPLOSIVES.

High Explosives: A Practical Treatise. By Capt. E. de W. S. Colver. Pp. xxix+830. (London: Crosby Lockwood and Son, 1918.) Price 3 guineas net.

CAPT. COLVER has written this large volume with the object of filling "a marked gap in English technical literature, which is sadly deficient in recent information on the subject of high explosives." Though one may not entirely agree with his statement that there is "very little collected information regarding the manufacture, properties, and use of modern high explosives," there is no such complete account as the author gives in this very comprehensive treatise, especially on the manufacture of these important compounds.

In dealing with this subject the author very naturally directs attention to the present difficulties which must be encountered by a writer owing to the impossibility of publishing certain information, so that it became necessary to restrict the work in many important particulars. Similar restrictions must also apply to criticism of the work for fear of transgression.

In the interesting introductory chapter the old controversy over the use of picric acid as an explosive crops up, and the author's statements are contradictory, for on one page it is stated that its detonating properties were discovered by Turpin in 1885, whilst two pages later Sprengel's address before the Chemical Society in 1873, in which he stated that "it is an extremely powerful explosive provided that it is ignited by a powerful detonator," is quoted. Again, later, Capt. Colver writes that it was Turpin's discovery which had given the explosive industry a particularly valuable new explosive.

The following section deals with raw materials and outlines the separation of the primary products. Although petroleum as raw material is not of great importance, more recent records of production than those for 1911 might have been given. No reference is made to the presence of aromatic hydrocarbons in certain petroleums, although for Russian petroleum "benzene" is twice mentioned as the first distillate, when it should obviously have been "benzine" (the specific gravity being 0·725).

In dealing with synthetic phenol, a raw material that has been made on a large scale, only one process of manufacture is referred to, the benzene-sulphonic acid method.

Very complete chapters deal with the nitro-compounds of the aromatic hydrocarbons and of the phenols and naphthols. Trinitrobenzene is stated to be the most suitable of the highly nitrated aromatic hydrocarbons for use as a detonating explosive, the proportion of oxygen giving it advantage over trinitrotoluene, as also does the maximum density attainable, 1·67 as against 1·62 for the toluene derivative. Although slightly more sensitive than T.N.T., it is less so than picric acid. Trinitrobenzene is not at present extensively used, probably owing to the difficulty and expense of manufacture. Attempts to nitrate T.N.T. more highly are shown to result in the formation of trinitrobenzoic acid, or even rupture of the benzene ring with the formation of tetranitromethane, the intense odour of which has been perceptible where decompositions have occurred during manufacture.

Less extensively employed nitro-derivatives, including hexanitrodiphenylamine and the polynitroanilines, and others which have scarcely reached the stage of practical application, are described. Tetranitroaniline is stated to have proved by practical tests the most powerful of all the explosives hitherto used. Several explosives of this class have been employed for aircraft bombs; thus mixtures of two parts of T.N.T. with one part of tetranitroaniline, or of hexanitrodiphenylamine (dipicrylamine), are stated to have been used by the Germans.

Search for suitable raw materials outside the pure chemical compounds has naturally engaged attention, principally in the directions of utilising tar products boiling over a wide range, and petroleum hydrocarbons. Naturally the nitro-products are complex in character; thus from coal-tar naphthas mixtures of solid and liquid nitro-products are obtainable, those from fractions boiling above 200° C. containing many nitro-derivatives of the naphthalene series. The nitro-products from petroleums are stated to consist generally of uncrystallisable masses of reddish-brown colour suitable only for certain plastic explosives. The possibility of obtaining generally useful materials by direct nitration does not appear promising. A sounder procedure would appear to lie in "cracking" the oils for the production of aromatic hydrocarbons which can be separated and then nitrated.

Indirectly prepared nitro-derivatives of paraffin hydro-carbons are of considerable interest, and the author considers that here is a profitable field of research. The remarkable substance tetranitromethane [$C(NO_2)_4$] has been patented as an oxidiser for other organic compounds, as in the Sprengel type of explosives. This compound is comparatively non-volatile, has no acid properties, is completely stable, insoluble in water, and not affected by it. Hexanitroethane [$C_2(NO_2)_6$] forms colourless crystals, which are extremely insensitive to percussion and friction.

Considerable space is given to the German rules and regulations governing the manufacture, etc., of explosives, the author considering that the ripe experience of the Germans justifies this. British regulations are not dealt with. There is a useful section on the toxic effect of raw materials and products. Some contradiction is evident over the relative liability of more or less highly nitrated products to produce ill-effects, for the general statement is made that the toxic effect of the lower grades of T.N.T. is greater than that of the pure substance, whilst in a previous passage the statement occurs that in general with the various nitrobenzenes (and nitrotoluenes), "as the number of the nitro-groups increase, the compounds have a proportionally greater toxicity."

A useful section deals with the manipulation and working up of the finished explosives, grinding, mixing, the filling of shells by plain casting, casting under pressure to increase the density of the charge, and by pressing the solid charge.

The later chapters are devoted to questions on the use of explosives, the measurement of pressures, energy, etc.; then follows an appendix containing a comprehensive review of patents (which is supplemented later by a "Patents Register"). A short further appendix deals with specifications. This last section is extremely meagre, but possibly restrictions were placed on the author in respect to British specifications, and moreover those handling the materials have to be familiar with the requirements.

The volume is inconveniently large; much space might have been saved with advantage. For example, graphic formulæ are unnecessarily large; in one instance three formulæ almost fill one page; subdivision into separate chapters where collection under one heading was possible has led to much blank space, and some very simple diagrams have a whole page devoted to each.

IS PSYCHOLOGY ONE OF THE NATURAL SCIENCES?

Psychological Principles. By Dr. James Ward. (The Cambridge Psychological Library.) Pp. xiv+478. (Cambridge: At the University Press, 1918.) Price 21s. net.

PSYCHOLOGY, ever held in high honour as a philosophical science, is to-day claiming to be one of the natural sciences. Sometimes it is distinguished as the new psychology. It regards its subject-matter as amenable to treatment in laboratories, and in two directions, one educational and industrial, the other medical and therapeutic, it appears to have established its claim to be assigned a special realm of scientifically classified facts.

Since 1884, the year in which Dr. Ward wrote the famous "Encyclopædia Britannica" article, the output of this new psychology in books and journals and society proceedings has been enormous, its variety almost defying classification. It ranges from statistics and correlations to elaborate hypotheses of the fundamental nature of the reality of psychical phenomena. Throughout this whole period Dr. Ward's "Encyclopædia" article has stood almost unchallenged in its authority as the exposition of the principles which must govern every science of the soul. There are only two books which can compare with it in this respect—namely, James's "Principles of Psychology" and Stout's "Manual," and these are in no sense rivals, for each of the three is unique. Yet we cannot help sympathising with Dr. Ward's disappointed feeling that the conditions necessarily attaching to an article in an encyclopædia are a serious handicap to its usefulness compared with the unrestricted form of the separate treatise. At last, however, we are allowed to have this important work in a volume, and the wonderful thing is that it appears, not as an overdue promise in the fulfilment of which we have lost interest, but as a new work with all the freshness of youth; and the large additions to the original article are not makeshift appendages, but natural developments.

No one who reads this book can fail to appreciate the significant service Dr. Ward has rendered to psychology. It is evident alike in the paths he follows and in those which he avoids as side-tracks, or turns away from as false routes. We are not invited, for example, to begin with a more or less detailed description of the nervous system, and we are therefore spared altogether that illusion which so powerfully influences the psychologists whom it fascinates, the illusion that it is only a little gap in our science, an unfortunate hiatus we have not yet succeeded in bridging, which prevents us passing directly from physiology to psychology, from the science of the nervous system to the science of the mind. Again, with a clear conception of its utter futility, Dr. Ward rejects the notion that psychical facts belong to the same order of reality as physical facts, differing from them only in their diaphaneity and elusiveness, but capable of being mathematically treated by cunningly devised psycho-physical apparatus. Dr. Ward's attitude towards such method is shown in a characteristic note in the preface, in which, apologising for the retention of the chapter on "Memorising, Rhythmising, and Reading," originally inserted "by way of illustrating the so-called new psychology," he adds: "If there is one chapter more than another in the book which may be 'skipped,' it is this."

The greatness of this book is not in its negations, but in the clear and masterly way in which it sets forth the principles that govern psychology. No development of the science, or possible discovery, can affect these. First and foremost is the principle of the unity of the subject of experience with his experience. This is fundamental in Dr. Ward's view, and insisted on in striking arguments and clear expressions. The point of view of psychology is individualistic. Psychology is the science of individual experience. As presented to an individual, "the whole choir of heaven and furniture of earth" may belong to psychology.

In close connection with this definition of the subject-matter and scope of psychology is the principle of the indissolubility of the subject-object relation in experience, and the inseparability of its factors into subjects of experience on one hand, and objects of experience on the other. The subject-object relation is not a dualism of two terms, but a duality in unity. The importance of this principle in regard to the status of psychology as a science can be easily seen. In the physical sciences we select among the objects of experience special groups and classes and treat them on the assumption that they are in their essence what they are known to be, that they are independent of the knower, and that they interact among themselves according to laws of nature. The whole success of physical science depends upon the justification in experience of this assumption. We cannot delimit the subject-matter of psychology in any such way. Subjects of experience are not a class of objects, and do not interact with objects in the way we assume that objects interact with one another. Psychology, therefore, is not one of the sciences in the sense that it possesses its own section or has its own department of the general stuff of reality. It deals with the whole of reality, but in a particular aspect and from a particular point of view.

The other fundamental principle on which Dr. Ward insists is closely allied to this, but still far from receiving general recognition. In psychology we are studying the activity of monads. The essence of this concept is that every subject of experience mirrors the whole universe from an individual point of view. There is no common universe which all subjects of experience share; the interaction of monads must be explained by a different scheme from that which serves us in physical science.

One-third of this book (chaps. xii.–xviii.) is new matter which had no place in the original "Encyclopædia" article. It is not new to those who have followed the vigorous development of Dr. Ward's thought in his Gifford lectures and occasional articles, and especially in the striking Henry Sidgwick lecture on "Heredity and Memory" (1913). It is no small compensation for the years during which we have had to resort to a reference library in order to study Dr. Ward's views that we have now in a single complete volume the gathered fruit of his life-work in its maturity.

H. WILDON CARR.

ORGANIC AND APPLIED CHEMISTRY.

(1) *The Chemistry of Synthetic Drugs.* By Dr. Percy May. Second edition, revised and enlarged. Pp. xii+250. (London: Longmans, Green, and Co., 1918.) Price 10s. 6d. net.

(2) *Organic Chemistry for Advanced Students.* By Prof. Julius B. Cohen. Second edition. Part i., "Reactions," pp. viii+366; part ii., "Structure," pp. vii+435; part iii., "Synthesis," pp. vii+378. (London: Edward Arnold, 1918.) Price 54s. net.

IT is a healthy indication of the increased interest which is being taken in applied chemistry that so much of the literature published at the present time deals with questions connected with the future development of chemical industry in this country. It is, of course, well known that at the outset of the war we experienced considerable difficulty in maintaining the supply of many of the synthetic drugs which up to that time had been procured almost entirely from Germany, and, but for the voluntary work done in many of the educational laboratories, there would have been no supplies whatever of some of the most valuable local anæsthetics.

(1) The publication of the second edition of Dr. May's well-known book is, therefore, to be welcomed in the hope that it may help to attract workers to a branch of chemistry which has not hitherto received in this country the attention which it merits. The text of the new edition does not differ materially from that of its predecessor, but we note that the chapter on "Organic Antiseptics" now contains a short account of Ehrlich's work on the trypanocidal dyes trypan blue and trypan red, as well as a mention of the flavines and their use in the treatment of wound infections. The inclusion of the chloramines in chap. xii. is also a new feature, and the section on salvarsan and its related compounds has been extended and brought up to date.

The book contains much useful and interesting information, and will no doubt continue to be freely consulted by those engaged in the manufacture of synthetic drugs.

(2) The publication of the second edition of Prof. Cohen's well-known book, however, serves as a timely reminder that no real progress can be made without a scientific foundation, and that the future of chemical industry is dependent upon the supply of scientifically trained chemists who must be conversant with the fundamental principles underlying the modern developments of their science. Since the publication of the first edition of this book in 1907 it has undoubtedly played a very important *rôle* in the training of students of chemistry in this country, and has been freely consulted both by students and by their teachers. The present edition has altered somewhat in outward form, consisting as it does of three volumes instead of two. The three volumes are devoted to "Reactions," "Structure," and "Synthesis" respectively, and by this arrangement it has been found possible to group together allied subjects and link them, so far as possible, in a consecutive form.

Considerable additions have been made to the subject-matter throughout the book; thus, for example, a useful chapter on "Abnormal Reactions" has been added to Part i., while in Part ii. the chapter on "Isomerism and Stereoisomerism" has been considerably improved by the inclusion of an account of recent work on the Walden inversion. The most important additions, however, have been made in Part iii., which deals with "Synthesis"; here we find considerably more space given to the carbohydrates for the discussion of the structure of glucose, the glucosides, and disaccharoses, as well as the chemistry of fermentation. The chapter on "Proteins" now contains a section on "Chlorophyll," but, curiously enough, no mention is made in the list of references to Willstätter and Stoll's book on this subject. The chapter on "Alkaloids" has been brought up to date by the inclusion of an account of Perkin's work on cryptopin and protopin, as well as a reference to Robinson's recent synthesis of tropinone. Considerable additions have also been made to the chapter on "Terpenes and Camphors." The new edition will be welcomed by all serious students of organic chemistry, and its success is assured.

OUR BOOKSHELF.

Studies in Primitive Looms. By H. Ling Roth. Part iv. (Bankfield Museum.) (Halifax: F. King and Sons.) Four parts, price 3*s.* each.

MR. LING ROTH has now completed his important technological monograph, of which four parts have recently appeared in the Journal of the Royal Anthropological Institute. In the introduction to the series he remarks that "weaving is generally considered to be the outcome of basketry and mat-making, and in most cases probably it is so." The arrangement of the monograph is geographical, and Mr. Ling Roth discusses the interesting problem of the origin of these varied types. Some, he thinks, were invented on the spot, and do not owe their origin to copying or to contact with other races. But this is not always the case. The African varieties—fixed heddle, pit treadle, and horizontal narrow-band—are all probably of Asiatic origin, the last having undergone so many modifications that, compared with its prototype, it is almost unrecognisable. The warp-weighted loom was used in ancient Greece, in the Swiss lake dwellings, and at the beginning of the Bronze age. It appears in Scandinavian saga in the eleventh century, and was probably in use by the Northern peoples many hundred years before that time. Mr. Ling Roth has illustrated his monograph with excellent sketches, drawn from all available sources, and his technical knowledge has helped him in discussing the various types. It may be hoped that he will extend his collection of papers, and republish them in a more accessible form.

Alfred Russel Wallace: The Story of a Great Discoverer. By L. T. Hogben. (Pioneers of Progress: Men of Science.) Pp. 64. (London: Society for Promoting Christian Knowledge, 1918.) Price 2*s.* net.

THE name of Alfred Russel Wallace is rightly held in honour as that of one who with few advantages of birth or education made for himself a distinguished position as naturalist and traveller, and who, besides adding largely to the acquaintance of scientific men with certain regions previously little known, and making extensive collections of their fauna, achieved independently the discovery of natural selection, the most illuminating principle ever enunciated in the history of biological study. It is obvious that the life of such a man cannot be treated adequately in a small book of sixty-four pages, and Mr. Hogben's volume does not pretend to be more than a sketch. In view, however, of his necessary limits, it is to be regretted that the author has not observed a better proportion in the selection of facts to be recorded. Details of Wallace's early life are interesting in their bearing on his later development, but we could have spared the account of the arrangement of desks and fireplaces in the grammar school at Hertford if Mr. Hogben had given us in its place a few more particulars of the exploration of the Amazon and of the Malayan islands. On the subject of geographical distribution the tone of the book is scarcely fair; and on p. 47, besides some careless punctuation, there is a distinct error of fact. With such amiable weaknesses as anti-vaccination and spiritualism we are not concerned, but we greatly miss a more extended account of the work that really made Wallace's reputation. F. A. 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.*]

Fuel Economisers.

I CAN corroborate Mr. R. C. Parsons's remarks in NATURE of December 26 with regard to the advantages of economisers connected with stoves, as I have had them in use for the last twenty-six years with very satisfactory results, the heating being better with a greatly reduced consumption of fuel. My economisers differ from those of Mr. Parsons only in being arranged symmetrically behind the stove, and not to one side of it; and in having an opening in the dividing partition in the box, which is usually closed by a damper, but can be opened so as to provide a direct passage for the gases from the stove to the chimney, so giving a better draught to the fire when it is being lit. During these years I have had two stoves and economisers in use here; one is a Gurney slow-combustion stove, which has an economiser of about the same heating area as itself. This stove goes day and night during the cold season. The other is a common cylindrical slow-combustion stove, and its economiser has got about twice the heating area of the stove, and is only occasionally used.

When the Gurney stove was first fitted in, it had no economiser, and the result was unsatisfactory. All the hot air went to the top floor, and the ground floor was but little benefited, as it received only the radiated heat. After the economiser was added conditions were entirely changed; all the ground floor was now much better warmed. The reason for the change is evident when we consider what takes place under the two conditions. With the stove alone a good fire had to be kept up, and the highly heated air ascended to the highest part in the house, and tended to remain there, where it lost its heat to the ceiling, which is the coldest part of a top room; but when the economiser was added there was double the heating surface, so a much larger amount of air was heated, though not to so high a temperature. The hot air did not now have the same tendency to keep near the ceiling and lose its heat there, and the larger volume of hot air put into circulation enabled all the air in the ground floor to be heated.

These things are better understood in Switzerland, and in other countries where fuel is dear, than is the case here. There one frequently sees stoves built of bricks and tiled, 4 ft. or 5 ft. in diameter, and from 6 ft. to 8 ft. high, with a small wood fire burning in the centre of them.

With regard to the common cylindrical stove above referred to, another advantage of the economiser is that after the fire is lit it at once begins to warm the room, whereas the outside of the stove takes an hour or two to heat through the fire-brick lining, while the economiser is heated and begins to warm the room almost at once.

If coke is used in the stoves there is no trouble with soot in the economisers, such as was found here with economisers used in connection with ordinary coal-stoked room fires. The stove economisers here require to be cleaned only once a year, principally for dust.

When the Government undertook the control of coal, plans and descriptions of the above economisers were sent to the Controller of Coal Mines.

JOHN AITKEN.

Ardenlea, Falkirk, December 27, 1918.

University Poverty or Parsimony?

SHORTLY before the war broke out there was some correspondence, in NATURE and elsewhere, with reference to the pay offered to chemists in advertisements of the Research Department of Woolwich Arsenal. Exception was taken to the offer of little more than 100*l.* a year to men who were supposed to have received training rendering them competent to undertake research work. As a result, I believe, the Department was led to attach a rate of pay to the posts not quite so inadequate as that first proposed.

Apparently during the war some slight conception of the value of chemistry to the nation has been forced upon the public. So much has been said about the importance of research that we are almost as willing as the Americans to "talk big" about it, and put emphasis upon the first syllable. We even recognise (on paper) an indissoluble connection between science and industry; in fact, so great is our advance that several literary men have been appointed, at high salaries, to supervise the expenditure of public funds on technical scientific inquiries. It is true the Board of Trade has systematically declined to associate science with the dyestuff industry, but only by way of being the exception to prove the rule. The Board, we know, is a superior body, and not to be led by any vulgar policy; the highest explosives would not cause its august officials to accept advice.

The President of the Board of Education, too, has often discoursed eloquently on the value of intelligence; moreover, the need of attracting intelligence, if not genius, into the chemical and other learned careers is a topic we never weary of airing in these days.

My object now is to direct attention to the way in which the learned are living up to their own professions, to urge that charity really should begin at home. I do this because my eye has casually fallen upon an advertisement in your columns in which applications are invited by the Vice-Chancellor of the University of London for a University chair of chemistry tenable at King's College at the princely salary of 600*l.* a year. Thus do we testify to our belief in ourselves. No man can fulfil the duties of such a chair adequately on such pay.

It can only be supposed that the University desires to write down the value of King's College chemistry in comparison with that taught at the South Kensington and University Colleges. A more effective way could not well be found, and in the interest of the subject it would undoubtedly be better to concentrate the teaching at two schools.

If, however, chemistry be retained in existence in the Strand, and funds be not forthcoming for the proper endowment of a chair, at most a lectureship should be established; and it would be wise to provide that candidates should not exceed about twenty-five years of age and should hold the appointment at most during ten years.

Let us hope that the profession will make no response to the invitation. Unless chemists themselves take some effective action to protect their interests, the position of chemical science in this country will not only be worse than it was before the war, but must steadily degenerate as years go on.

HENRY E. ARMSTRONG.

Inter-Allied Conference on International Organisations in Science.

IN the account of the Inter-Allied Scientific Conference at Paris published in NATURE of December 26, reference ought, perhaps, to have been made to the status which it has been decided to give to the self-governing British Dominions. These will be able to join any international association under the proposed scheme, on signifying their intention to do so, with the same voting power as independent States.

ARTHUR SCHUSTER.

Yeldall, Twyford, Berks, December 27, 1918.

SCIENTIFIC RESEARCH AND PREVENTIVE MEDICINE.

IT was stated recently in these columns that the toll of pain and death due to causes which are more or less preventable may be gauged in terms comparable with those demanded by the sufferings directly attributable to war. In order to reduce such sources of national loss it was considered important that in the evolution of schemes for the furtherance of research work in pure and applied science the question of the encouragement of research work in all branches of medical science should occupy a prominent place. The pandemic of influenza recently experienced may be taken as an illustration of the need for wide-embracing and well-organised research work in preventive medicine, and particularly in epidemiology. That such an epidemic would well deserve thorough and extensive investigation seems self-evident. According to the medical correspondent to the *Times* of December 18 and 19, 1918, there is good reason to estimate the world's death-roll from influenza and pneumonia at not fewer than 6,000,000 lives, at which rate he points out that this epidemic has been five times as deadly as the war during the same period of three months. Now a visitation on such a scale as this, in which many of the victims are in the prime of their lives, is comparable with the great plagues of the Middle Ages, and, coming at such a time as the present, is catastrophic from whatever point of view it may be regarded.

Epidemics of influenza have recurred at intervals for some hundreds of years, and in recent times have fallen on us in 1803, 1833, 1837-38, 1847-48, and 1889, when it became annual for several years. From 1860 to 1889 the disease became practically extinct, the mortality per 1000 being about 0·003. Even during these epidemics the case mortality was low when compared with that which has obtained in the present outbreak, and was estimated at 1 to 1·6 per 1000. One of the most remarkable features of the recent epidemic is the tendency to the development of very acute toxic symptoms with such astounding rapidity that the body of the victim is overcome by the poison before defences can be put up; in any case, the defence is of a very temporary nature, so that there is always the possibility of further attacks overwhelming the enfeebled commonwealth of cells, if exposed to reinfection. It is possible that in earlier epidemics the causal relationship between influenza and fatal lung and heart failure was less clear than it is in the recent one, and might have been overlooked, although the coincidence between outbreaks of toxic pneumonia and influenza has long been known. In some respects circumstances are now very favourable to the spread of such infectious disorders: overwork is a common condition; our national dietary, cleverly controlled though it be, cannot be regarded as a normal one, since freedom of choice is limited; overcrowding is in many areas inevitable, and doctors are few.

As is the case with other contagious diseases which have shown a tendency to increase of late years (diphtheria, for example), the fundamental causes of the epidemic are unknown, and are to be discovered only by widely organised co-operative investigation. It is not even certain that we are dealing with the same organism as is responsible for the causation of so-called "influenza" during non-epidemic times: if it is the same, then the causation of the sudden increase in virulence remains to be explained; if not, then we are confronted with the problem as to the origin of the germ, or as to its lurking-place in the interim between epidemics, or as to the causes of the subsidence of the prevalence of its effects. It is known that passage through hosts belonging to a different species may either augment or diminish the virulence of bacteria to man, and the relation of influenza to the somewhat similar affection of cats and dogs and to the condition known as "pink-eye" in horses is perhaps worth definitely clearing up. The tendency to recurrence, and especially to the recurrence of a particular variety of this polymorphic disease in the same locality, has led to the view that the germ possibly lurks in the soil, or, as suggested by a correspondent to the *Times Engineering Supplement* of December 19, in drains.

The mode of spread of influenza along lines of traffic suggests that the disease is communicated by personal contact, and the success which has attended the wearing of gauze masks as a means of protection not only indicates the usual method by which infection is incurred, but also shows what can be accomplished by the adoption of simple measures of safeguard. The condition is known to be extraordinarily infectious, even in the early stages, and there can be no doubt that it is often widely, though unwittingly, spread by those with slight attacks determined to "carry on"; anyone so doing not only lays himself open to the possibility of fatal complications, but may also infect a large number of others in the meantime, and the fact that his own attack was a mild one is no security that the disease transmitted to others will be of a similar degree of severity. We are not even certain that the disease may not be spread by "carriers" themselves in apparent health, although this does not seem likely.

The Medical Research Committee has already collected a good deal of information with regard to this epidemic, and it is sincerely to be hoped that a means will be found by some such organised body of workers for preventing its further spread or repetition. Researches into this subject will be valuable, not merely as contributions to bacteriology, but also as useful material for the study of epidemiology in general.

What applies to influenza applies with equal force to other infectious diseases; in all cases there is a pronounced liability to leave chronic organic diseases as after-effects. Although medical attention is necessarily attracted to these chronic states, it seems obvious that proper attention to their fundamental causation would not only be more worthy of the name of research, but also lead to results of permanent value in connection with public health. For example, regular and systematic examination of the heart by means of the electro-cardiograph and other appliances for the exact investigation of the heart in all cases of infectious disease would probably throw light on one of the underlying causes of disablement by chronic heart disease. The same is true of the investigation of the activity of the kidney on the lines of experimental physiology and experimental clinical medicine. The medical correspondent to the *Times* of December 24 has rightly directed attention to the fact that the influenza epidemic, "with its 6,000,000 deaths and its incalculable disablement, is the price of public indifference to health affairs"; research into epidemics, he states, must begin in the fever hospitals and in general practice, where the cases are to be met. Such research must necessarily be organised, and its results integrated after careful sifting by some centralised body of experts. The records of properly conducted investigation into malaria, kala azar, syphilis, diphtheria, tetanus, trench fever, typhoid, and sleeping sickness have led to valuable results, although much more remains to be done. Who has heard of extensive research work on measles, scarlet fever, or whooping cough in recent years; yet who doubts that these diseases may leave many and serious after-effects which often need very prolonged treatment in after-life, and incontestably produce extensive disablement? The most stultifying of all attitudes is that which leads medical practitioners to "treat symptoms as they arise." More attention should certainly be focussed on the causation of these symptoms, and in the infectious diseases we have very prolific sources of chronic disease.

WIND CIRCULATION OF THE GLOBE.

UNTIL some twenty years ago meteorology was regarded as an elementary science founded on theories so simple that they might be taken as self-evident. Thus the cyclone was looked upon as a warm column of rising air with spirally inflowing winds at its base; the anticyclone, conversely, contained a cold core of descending air. Now we know that the opposite is in reality the truth; the cyclone has a cold core, the anticyclone a warm one. Another theory of equal simplicity and perhaps of even greater antiquity explained the general circulation of winds around the globe. It was argued that solar heating made the equator very much warmer than the poles; therefore there must be a rising current at the equator, a poleward flow of air in the upper layers of the atmosphere, a descending current in polar regions, and an equatorial flow in the lower layers. To question the validity of such a theory would have been regarded as almost an impertinence.

In a recent paper[1] Hildebrandsson has dealt in a comprehensive manner with this question of world circulation, avoiding preconceived theories, but collecting all available information on the subject. Incidentally he puts forward several very cogent reasons why the simple theory outlined above is untenable, though there can be few meteorologists of the present day who regard it at all seriously. The main surface currents have for a long time been fairly well known, and it is with the upper winds of the troposphere that the greater part of this paper is concerned. The chief sources of information are (1) cloud observations from the international network of stations which observe cloud motion, and (2) results of pilot-balloon and *ballon-sonde* ascents. The former afford the larger body of data, while the latter present more detailed information and provide valuable confirmation of the general conclusions otherwise arrived at.

The main general system of world currents is made up as follows:—(1) Over the thermal equator there is a current from east to west at all heights, weak near the surface of the earth, but very strong in the upper layers of the atmosphere. (2) In the temperate zones the currents are from west to east. In the lower layers of the atmosphere the intermediate regions between these two current systems contain the tropical anticyclones and the trades, which blow from N.E. in the northern hemisphere, and from S.E. in the southern. In the upper layers the easterly wind over the equator veers in the northern hemisphere successively to S.E., S., and S.W. as one passes northward, thus turning into the well-known counter-trades. These feed the upper part of the tropical anticyclone from the equatorial side, while the polar side is similarly fed by a deviation of the main westerly current to N.W.

The above form the chief wind systems of equatorial and temperate latitudes. In arctic and antarctic regions data are more scanty, and the wind currents do not seem to fall into any such simple system in these parts of the globe. It is interesting to learn that the great monsoon currents, which have such an important influence on the meteorology of many regions of the earth, are relatively shallow, being not more than 4 km. to 5 km. in depth. They must be regarded only as great perturbations in the general system of circulation outlined above. Similarly, the cyclones and anticyclones of temperate regions are phenomena of the lower layers, above which blow in general the undisturbed westerlies at great heights.

A valuable feature of the paper is the numerous tables, which set out the data obtained from different parts of the globe. Mention must also be made of two charts showing the upper wind currents which prevail above the North Atlantic "High" in summer and winter. It is unfortunate that practically no velocities are given, wind directions only being dealt with. The reasons for this are fairly obvious in the case of cloud data, but it would have added to the value of the discussion if in the tabulated pilot-balloon observations wind velocity had been given as well as direction. Throughout the paper directions are indicated by degrees from one of the cardinal points, but no uniform plan seems to be followed. There appears little justification for denoting a direction as N. 70° W. in one place, and W. 20° N. in another, to quote one example. It is desirable to point out that the references on pp. 12–17 to the plates at the end of the paper are mostly in error. These detail imperfections do not, however, appreciably detract from the great value of the paper as a comprehensive study of world air currents.

J. S. D.

[1] "Résultats des Recherches Empiriques sur les Mouvements Généraux de l'Atmosphère," Nova Acta Regiæ Societatis Scientiarum Upsaliensis, ser. 4, vol. v., No. 1. Pp. 50+plates. (Upsala, 1918.)

THE VISIT OF PRESIDENT WILSON.

THE visit of Mr. Wilson to Europe, and to England especially, is an event of the highest moment, not merely because it is the first time that a President of the United States has left the shores of his great and powerful country, but also because he has come upon a mission of grave consequence—so grave, indeed, that he has deliberately set aside all precedent—to the civilisation of the world, and to help in the settlement of the public affairs of a continent plunged into a welter of confusion unparalleled in the history of man. He comes, though a participator, and in large measure a determining factor, in the victorious issue of the colossal efforts made to meet the imposing onslaught on men's liberties on the part of a great autocracy backed by all the immense resources of modern science, with a message of reconciliation and goodwill to the nations concerned in the dreadful struggle of the last four and a half years. We are all now confronted with the arduous duty of laying the foundations of a new polity which shall assure the means, through long years of tribulation it may be, of a progressive, contented life in harmony with the well-being of humanity. Mr. Wilson comes armed with the spirit of right and justice; he will maintain the one and demand the other, and he trusts to the essential power of these two great principles to ensure the conditions of a firm, just, and lasting peace. He has shown himself, from the time he led his nation into the struggle, to be a man of high courage, with a real grasp of affairs, and of unwavering loyalty to high ideals and to the truth; and his visit here has been hailed with delight by all men of goodwill.

The State banquet given by the King and Queen at Buckingham Palace on Friday, December 27, in honour of the President and Mrs. Wilson marked an occasion of high significance, not only to the two nations united by it, but also to all free peoples. It was the historic expression of a union formed in a common cause and strengthened by the common purpose of establishing peace and freedom among the communities of the world. "You come," said the King to the President, in proposing the health of the principal guests, "as the official head and spokesman of a mighty Commonwealth, bound to us by the closest ties. Its people speak the tongue of Shakespeare and Milton. Our literature is yours, as yours is also ours, and the men of letters in both countries have joined in maintaining its incomparable glories." In President Wilson the scholar is combined with the statesman, and knowledge is associated with the courage of conviction. He has crossed the Atlantic to promote the spirit of brotherhood in the hearts of men, and "to make the right and the justice to which great nations like our own have devoted themselves the predominant and controlling force of the world." When these ideals are realised, a new epoch in the history of mankind will begin; they were advanced by the exchange of pledges at Friday's banquet and by the hope expressed by the King that the brotherly spirit which brought the response to the call of humanity would "inspire and guide our united efforts to secure for the world the blessings of an ordered freedom and an enduring peace."

It is gratifying to notice that, in addition to members of the Government and other statesmen, the distinguished guests at the banquet included leading representatives of science, as well as of art and literature, among those present being Sir J. J. Thomson (president, Royal Society), Major-Gen. Sir George Makins (president, Royal College of Surgeons), and Dr. Norman Moore (president, Royal College of Physicians).

NOTES.

THE list of New Year honours includes the following names of men known in scientific circles:—*Baronet:* Sir Lewis Amherst Selby-Bigge. *Knights:* Dr. W. Leslie Mackenzie, medical member of the Local Government Board for Scotland; Dr. G. D. Thane, principal inspector under Cruelty to Animals Act, Home Office; Dr. Prafulla Chandra Rây, Indian Educational Service, Bengal; and Col. Sir Almroth E. Wright, Army Medical Service. *K.C.V.O.:* Sir George Anderson Critchett, surgeon oculist to the King. *C.S.I.:* Dr. H. H. Hayden, director of the Geological Survey of India. *C.B.:* Mr. C. E. Ashford, headmaster, Royal Naval College, Dartmouth; Mr. P. W. L. Ashley, assistant secretary (Department of Industries and Manufactures), Board of Trade; and Dr. R. B. Low, assistant medical officer, Local Government Board. *C.M.G.:* Mr. Frank Tate, Director of Education, Victoria. *C.I.E.:* Lt.-Col. J. T. Calvert, principal, Medical College, Calcutta; Dr. W. Crooke; Mr. C. G. Roberts, Chief Conservator of Forests, Burma; Mr. T. R. D. Bell, Chief Conservator of Forests, Bombay; Mr. W. F. Perree, Conservator of Forests, Kumaon, United Provinces; Mr. B. B. Osmaston, president, Forest Research Institute and College, Dehra Dun; and Prof. J. C. Lamont, professor of anatomy, Medical College, Lahore, Punjab.

AT the annual meeting of the English Forestry Association held on December 18, Major G. L. Courthope, the president, gave some interesting details on the timber requirements of the Government and the available supplies existing in the country. The position is sufficiently serious to require earnest attention. The Timber Supply Department, the president said, was anxious to close down as soon as possible, but the Government looked to it to ensure the supplies which would be required during 1919. The demand alone next year, irrespective of commercial and trade demands, was expected to amount to 100,000 standards a month. There was nothing approaching that quantity in this country. The Department had rather more than a year's supply on the stump, calculated on the basis of the existing rate of output. The Controller of Timber Supplies had informed them that the shipping position was getting easier, but it would be some time before anything like adequate supplies of imported timber could be expected. There was a world shortage, and the countries which had supplies of converted material were holding them up for better prices. The foreign forestry workers (Portuguese, Finns, etc.) were being demobilised, and the demobilisation of the Canadian Forestry Corps was soon to take place. In their stead 16,000 demobilised British soldiers would be employed. It was certain that this country would require from 300,000 to 350,000 standards for reconstruction purposes during the next twelve months. In the United Kingdom there were something like 4½ million standards remaining standing. We imported 3,000,000 standards in 1913 alone. Lord Selborne said that if British landowners had not been far-sighted and public-spirited enough for generations past to carry on their plantings, in the absence of any public encouragement of any kind, this country would have been far more handicapped in carrying on the war than had been the case. The existence of the woods in Great Britain had saved the shipping situation on one hand and the coal situation on the other.

WE regret to learn, from the *Journal des Observateurs,* that M. Luizet, assistant at the Lyons Observatory, died on November 20, 1918. M. Luizet's special field was the observation of variable stars, and he prepared reports on this subject which have appeared from time to time in the *Journal.*

WE regret to notice the death on December 23, as the result of an accident, of Dr. Leonard G. Guthrie, distinguished by his work in nervous diseases and the history of medicine. Dr. Guthrie delivered the Fitzpatrick lectures at the Royal College of Physicians in 1907–8, and as secretary and vice-president of the section of medical history at the Royal Society of Medicine he did much to further that branch of research. He was president of the Harveian Society of London in 1913–14.

THE first lecture of the second series arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, January 8. The chair will be taken at 4.30 by the

Marquess of Crewe, K.G., and a lecture entitled "Industrial Unity" will be delivered by the Right Hon. G. H. Roberts, M.P., Minister of Labour. Applications for tickets should be made to the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4.

AT the general meeting of the Scottish Meteorological Society, held on December 19, the following officers and other members of council were elected for the ensuing twelve months:—*President:* Dr. C. G. Knott. *Vice-Presidents:* Prof. T. Hudson Beare and Mr. J. Mackay Bernard. *Council:* Mr. D. A. Stevenson, Mr. R. Cross, Mr. S. B. Hog, Mr. G. Thomson, Dr. A. Crichton Mitchell, Mr. G. A. Mitchell, Mr. M. M'Callum Fairgrieve, Prof. R. A. Sampson, and Capt. T. Bedford Franklin. *Hon. Secretary:* Capt. E. M. Wedderburn. *Hon. Treasurer:* Mr. W. B. Wilson.

IN *Helvetica Chimica Acta,* No. 4, appears an obituary notice of Prof. R. Nietzki, who for many years occupied the chair of chemistry at the University of Bâle, and had become noted for his work on the chemistry of certain groups of dyestuffs. Prof. Nietzki was born in 1847, and studied pharmacy in his early career. Later he became an assistant to A. W. Hofmann, and in 1876 held a similar position at Leyden, where he began the researches on colouring matters to which much of his life was afterwards devoted. He discovered nitranilic acid, and worked out the methods of preparing quinone and hydroquinone which are still employed for making these articles. In 1879 Prof. Nietzki accepted the post of research chemist with a firm at Biebrich, and signalised his appointment by the discovery of the dyestuff known as "Biebrich Scarlet," of which notable quantities are produced at the present time. He went to Bâle in 1884, and in association with his students continued his researches until ill-health brought about his retirement in 1911. The notice of his death, which occurred in September, 1917, is contributed by Prof. Noelting, who includes in it an important summary of Prof. Nietzki's investigations on aniline black, the quinones, azo-derivatives, safranines, oxazines, thiazines, and other groups of organic compounds.

DR. CHARLES R. VAN HISE, long connected with the United States Geological Survey, died on November 19 last, aged sixty-one years. His work, aided by the liberal system of Government publication at Washington, may be truly described as monumental. In 1883 he was called on to examine the iron-ore region of Lake Superior, under R. D. Irving, and five years later this work came under his control. His important summary of the grouping of the iron-ores appeared in 1897 (21st Ann. Rep., U.S. Geol. Survey, part 3), accompanied by a monograph on "The Marquette Iron-bearing District," in which W. S. Bayley co-operated. This monograph, No. 28, contains descriptions and an admirable series of coloured illustrations of siliceous banded iron-ores, which are of fundamental importance for comparison with similar rocks throughout the world. Dr. Van Hise extended the petrography of this subject in 1911 in his monograph (No. 52) on "The Geology of the Lake Superior Region," in collaboration with C. K. Leith. We owe to this work the experimental investigation of Leith's "greenalite," a marine silicate distinct from glauconite, and a close consideration of how far the magnetite in the bedded ore-deposits is a product of reduction from iron carbonate or greenalite, or how far it may be ascribed to transference from intrusive basic rocks. Meanwhile, Dr. Van Hise had issued his great "Treatise on Metamorphism" (Mon. 47, 1904), in which he reviewed all the changes undergone by rocks since their first stage of deposition or consolidation. Such varied subjects as the disintegrating action of white ants, the decomposition of silicates, and the flow of rocks under pressure, come within the range of this comprehensive work. Pre-Cambrian formations naturally attracted much of Dr. Van Hise's attention; but his range of reading was wide, and his duties as president of the University of Wisconsin brought his experience as an administrator into a high educational field.

WE regret to announce the death of Mr. J. P. Johnson at Johannesburg from pneumonia, following an attack of influenza, at the early age of thirty-eight. Mr. Johnson was born in London in 1880, and was educated at Dulwich College and the Royal School of Mines. In 1902 considerations of health compelled him to emigrate to the Transvaal. On the outbreak of the war he was living in Tasmania, where he intended to settle, but returned to South Africa, where he died on October 18, 1918. At an early age Mr. Johnson was an enthusiastic student of the Pleistocene deposits of England and of stone implements, and several papers were contributed by him to the Proceedings of the Geologists' Association, the *Geological Magazine,* the *Essex Naturalist,* and *Science Gossip.* He was a born hunter, and made many important additions to the Pleistocene faunas of West Wittering and Ilford and the Eocene fauna of Walton-on-the-Naze. In South Africa he found an almost virgin field, and the results of his work were embodied in "The Stone Implements of South Africa" (1907, second edition 1908), "Geological and Archæological Notes on Orangia" (1910), "The Prehistoric Period in South Africa" (1910, second edition 1912), and numerous papers published by the Geological Society of South Africa, the South African Association, the British Association, and in the columns of NATURE. Mr. Johnson was a member of the council of the Geological Society of South Africa, and was appointed by the South African Government a member of the Commission to report on the petroglyphs and rock-paintings of South Africa, many of which are reproduced in "The Prehistoric Period in South Africa" (second edition). He was also a keen student of the ethnography of South Africa, and his conclusions are embodied in the same work, of which a third edition was in hand at the time of his death. In his profession as a mining expert Mr. Johnson was greatly respected, and his services were urgently sought for by prospecting syndicates, whilst his works on "The Mineral Industry of Rhodesia" and "The Ore Deposits of South Africa" are standard books.

THE party of American technical journalists recently on a visit to this country as guests of the Government was entertained by the Master and Wardens of the Worshipful Company of Stationers on December 18, together with a gathering of British colleagues. The meeting had been arranged by the Institute of Journalists' Circle of Scientific, Technical, and Trade Journalists, and, in spite of the unavoidably short notice arising from some uncertainty regarding the return of the American party after its tour in France, a considerable number of editors of technical papers in London were present. After tea and a reception a meeting was held, at which Mr. H. C. Parmelee, Mr. S. O. Dunn, Mr. H. Cole Estep, Mr. H. M. Swetland, and Mr. A. J. Baldwin delivered short addresses on behalf of the American technical journalists, while Mr. L. Pendred, Prof. R. A. Gregory, and Mr. A. C. Meyjes responded for the British technical Press. It was very pleasant to note, in the addresses of our friends from the United States, that they were entirely at one with us in their appreciation of the importance of the duties which the technical Press can perform. Some striking instances of the services rendered in connection with the war and their influence on the industrial development were given, and stress was laid on the value of wide and thorough training, with the view of raising the status of technical journalism as a profession. A resolution was moved by Mr. H. C. Parmelee, seconded by Mr. A. C. Meyjes, and carried unanimously, urging the desirability of closer co-operation and periodical exchange of views between the trade and technical Press in the two countries. Mr. L. Gaster, chairman of the circle, who presided, voiced the pleasure of the meeting in welcoming the guests, and Mr. A. J. Baldwin expressed the hope that British technical journalists would reciprocate by sending a deputation to the United States in the near future.

In the *Scientific Monthly* for November (vol. vii., No. 5) Dr. Philip A. Means describes the social conditions of the Piura-Tumbes region of northern Peru. The population is divided on ethnic lines into three groups: pure Indians, pure whites, and mestizos (*i.e.* those of mixed ancestry). The landowners are, for the most part, of the white races; the Indians are engaged either in agriculture for the landowners or on the coast in fishing; while the mestizo class is occupied in shop-keeping, hotel-keeping, and kindred employments. In spite, however, of the excellent climate and the abundance of fruits and vegetables, the condition of most of the people is far from idyllic; their houses are often wretched huts indescribably dirty, while their personal habits are so unclean as to encourage disease. The author makes a plea for a benevolent paternalism in government, aiming at building up a wholesome, sane, and virile peasantry. The people have a peculiar aptitude for hand-weaving, which, if rightly encouraged, might both make the region world-famous for woven fabrics and help to develop the inhabitants. Excellent cotton and wool are already produced there, and with proper scientific study silk and flax could be grown in large quantities. Dr. Means suggests that the genius of the people for hand-weaving should not be suppressed by the introduction of mechanical methods, but encouraged, and in time, with the right sort of loom, the inhabitants would quickly show the world new kinds of cloth by new combinations of material. Tile-making he would also encourage. Other interesting suggestions for the development of this region are put forward in the article—suggestions which are pertinent to regions other than that of Piura-Tumbes.

The rapid increase and spread of the great crested grebe in Warwickshire forms the subject of a short paper by the late Mr. Geoffrey Leigh in *British Birds* for December. On the majority of pools already in use the number of breeding pairs is increasing yearly, whilst fresh sheets of water are being constantly occupied. The author expresses the opinion that this species is, as a rule, double-brooded. This increase apparently dates from about the year 1900, and it is to be hoped that it will receive no check.

In the *Irish Naturalist* for November–December Mr. R. F. Scharff expresses the opinion that the red deer found in Ireland to-day are the descendants of the indigenous stock of the island, and casts doubt on the trustworthiness of the statement that red deer were imported into Ireland during the thirteenth century from England. There can be no room for doubt that in prehistoric times the red deer roamed in great numbers all over the island, and the author holds that it is unlikely that in the thirteenth century this native race would have been so reduced as to need reinforcement.

That the Zoological Society of London has come through a time of severe stress and anxiety with remarkable success there can be no question, even though, as announced at the monthly general meeting held on December 1, there has been a great falling off in admissions to the gardens during 1918 as compared with the corresponding period for 1917. There has also been a similar decrease in the number of fellows elected and re-elected. We may, however, anticipate a steady and lasting improvement now that the disturbing factors are disappearing. The most important addition to the gardens during December was a Kea parrot (*Nestor notabilis*).

Many years ago it was pointed out by Prof. Bryan in *Science Gossip* that the pollen-grains of certain plants exhibit marked "black-cross" effects in polarised light. The Journal of the Royal Microscopical Society for September last contains an abstract of a paper by Mr. F. J. Keeley in the Proceedings of the Academy of Natural Sciences of Philadelphia dealing with polariscopic effects produced by certain diatoms. These effects, which were previously discussed by Mr. E. M. Nelson, are probably attributable to internal reflections, an explanation which may, perhaps, apply equally well to the pollen. The existence of these effects in *Actinocyclus ralfsii* has led to Mr. Keeley observing an exceedingly delicate secondary structure in this optically remarkable diatom.

The preservation of game-birds in its relation to agriculture has for some time past become a subject of political controversy, and it is therefore gratifying to find the subject treated in a scientific spirit by Dr. Walter E. Collinge, of St. Andrews, in *Science Progress* for October last. Dr. Collinge has conducted an extensive series of examinations of the contents of the crops of the three principal game-birds, namely, the pheasant, red grouse, and partridge. The proportions of animal matter are 37·4, 22·5, and 40·5 per cent. respectively, this consisting mainly of injurious insects, with very small percentages of worms, slugs, and non-injurious insects. Of the vegetable matter the percentages of grain are 2·4, 1·5, and 3·5, the great bulk being described as "leaves, stems, and seeds of weeds." In view of the benefits which these game-birds are capable of conferring upon agriculture, Dr. Collinge contends that, apart from all other considerations, their preservation is a question of urgent national importance. On the other hand, he advocates the systematic destruction of other species of birds, such as the house-sparrow, rook, and starling, which are costing the country millions of money in the food products destroyed.

In the Kew Bulletin, No. 7, a further instalment of "Notes on the Flora of Madras" is published by Mr. J. S. Gamble, the author of the flora now in course of publication. These notes deal with the natural families and genera which form part ii. of the flora, "Celastraceæ to Leguminosæ—Papilionatæ," which has recently been published. Among plants of unexpected occurrence in Madras may be mentioned *Leea aequata*, which is found in Bengal and Burma, and *Turpinia nepalensis* (Staphyleaceæ), a Himalayan mountain species found in the Madras mountains. Mr. Gamble proposes six species of the difficult genus Nothopegia; one of these, *N. dalzelli*, was originally described by Dalzell in 1849 as a new genus, Glycycarpus, and about three of the others there has been considerable confusion, now admirably settled by Mr. Gamble's careful researches. In the same issue he describes ten new species of South Indian Rosaceæ, Myrtaceæ, and Melastomaceæ.

THIS year, 1919, which is the centenary of the founding of the settlement of Singapore by Sir Stamford Raffles, marks also the sixtieth anniversary of the establishment of the Botanic Gardens. In the year 1859, on November 12, the Singapore Agri-Horticultural Society was formed, and received the support of the Governor, Col. O. Cavanagh, who afterwards became chairman of the committee of management. Within six weeks of the formation of the society some fifty-six acres of abandoned Government land were granted, as well as convict labour for setting in hand the cultivation of the garden site. The history of the establishment of the gardens is given in the Gardens Bulletin, Straits Settlements, vol. ii., No. 2, with a map showing the area granted to the Agri-Horticultural Society in 1859, and the further grant of land in 1866. The site is still occupied by the Botanic Gardens. Originally the society hoped to benefit local agriculture, but as its first object it set about preparing a pleasure garden for public resort. Between the years 1870–74 the society appears to have lost interest in the gardens, and have got into difficulties, so much so that in 1874 it offered to hand over the gardens to the Government. This was done in December, 1874, and the advice of Sir Joseph Hooker, then director of the Royal Gardens, Kew, was sought as to a superintendent. In October, 1875, the new superintendent, James Murton, selected by Hooker arrived in Singapore with a large supply of plants, and carried on the able work done by Lawrence Niven, the first superintendent, to whom the general lay-out of the gardens is due. From Murton's day to the present time the Singapore Botanic Gardens have become renowned as the centre of Great Britain's botanical activity in the Far East.

THE September issue of the *Scientific Australian* gives the results of the tests of New South Wales timber made by Prof. Warren, of the University of Sydney, for the Defence Department of the Commonwealth Government. The three timbers tested gave the following mean values for the modulus of rupture in lb. per square inch:—Ironbark, 29,000; blue gum and spotted gum, each 22,000. These values compare favourably with those found in the United States Government tests of American hickory, of which seven varieties gave mean values of from 12,000 to 19,000, while each variety showed a wide range of quality. It seems desirable that the great strength of these New South Wales timbers should be known to engineers in this country.

SAWDUST, chips, and shavings are largely utilised in Germany for the production of alcohol. It is estimated that from half a million to one million tons of such waste material are produced annually in that country. Four distilleries are at present being run on these raw materials, each having fifty-one autoclaves of 1000-kg. capacity. The cost of production is said to be high when the residue cannot be used as cattle fodder or the waste liquors used for other products. The material is heated in an autoclave with either sulphurous or hydrochloric acid for from twenty to forty minutes at 265° C. at a pressure of 7 atm., then quickly drawn off, neutralised, and run into the fermenting vat, beer-yeast being used. Distillation completes the process. Further particulars are given in *Zeitschrift für angewandte Chemie* for September 13 last.

IN *Elektrotechnik und Maschinenbau* for September 1 are given the results of some investigations by Gumlich on the magnetic properties and resistance of iron alloys. The samples consisted of pure electrolytic iron and four series of alloys with increasing carbon content (up to 1·8 per cent.). The density and specific resistance vary with the percentage of added material. The tests also showed that the magnetic properties of iron are not improved appreciably by the addition of silicon and aluminium. The benefit derived by the presence of these materials is only due to secondary causes by virtue of the removal of oxygen and neutralisation of the effect of carbon. Eddy-current losses are reduced by the addition of silicon and aluminium. The effect of the added materials on the coercive force is also examined. Good permanent magnets may be produced by adding tungsten, chromium, or molybdenum.

THE second number of the *Decimal Educator*, a quarterly publication of the Decimal Association, contains extracts from several articles by prominent writers in favour of the metric system of weights and measures, including the article by "A. F. B." which appeared in NATURE for August 30, 1917. In connection with the misapprehension which is often to be found in industrial circles regarding the difficulties and expense that would be involved in the compulsory adoption of the metric system, it is pointed out that the proposals of the advocates of the system do not include any obligation to use metric measures in manufacturing operations, but only in commercial transactions. Many useful hints for lecturers on the metric system are to be found in the article on teaching the system, which is continued in this issue. The undesirability of over-elaborating the difference between the values of corresponding metric and imperial denominations is insisted upon, and it is shown that in most cases there are simple approximate relations which will suffice for all practical purposes. An account is given of the present stage of the proposal for introducing decimal coinage, and from correspondence which appears in this issue it would seem that the movement is receiving considerable support throughout the country.

WE have received a letter from Dr. G. C. Simpson, meteorologist to the Government of India, on the subject of aurora at low heights in the atmosphere, supplementary to one from him which appeared in NATURE of September 12 last (p. 24). Dr. Simpson now informs us that the Scott Antarctic Expedition of 1911–12, of which he was a member, had with it "a complete equipment for determining auroral heights by Prof. Störmer's photographic method, but, unfortunately, the experiments made were unsuccessful." In some comments on Dr. Simpson's previous letter Dr. Chree expressed the hope that the observers of the next Arctic or Antarctic expedition would be familiar with what had been written on the subject, and be specially careful in dealing with any apparently low-level aurora. Dr. Simpson is apprehensive lest this should be supposed to imply censure on the observers of the Scott expedition. We can assure him that no reflection whatever was intended on the observers of *any* previous expedition. The subject, as Dr. Simpson's letter alone would suffice to show, is beset with pitfalls for the unwary, and it is important that *future* observers should realise adequately the completeness of the evidence necessary to establish the existence of aurora at really low levels. Dr. Simpson's own writings on the subject form part of the literature the study of which we should like to recommend.

THE *Engineer* of December 20 reviews the project known as the Georgian Bay Canal, which will probably be undertaken by the Canadian Government at an early date, now that the war has ceased to impose a veto on civil engineering enterprise. The design of the waterway in question is to link up the arm of Lake Huron, called Georgian Bay, with the St Lawrence River at Montreal. It will undoubtedly prove a great convenience for water-borne grain traffic, which at present is conveyed from Fort William and Fort Arthur on Lake Superior to Montreal *via* Lakes Huron, Erie, and Ontario. The new route, embracing a total distance of 440 miles from the entrance at the mouth of French River to the city of Montreal, will constitute a saving of 282 miles. There are naturally 346 miles of navigable lake and river and 66 miles of channel, in which the requisite depth can be obtained by dredging, leaving 28 miles only of canal to be constructed. There is a rise of 98 ft. between Georgian Bay and the summit level at Trout Lake, which will be surmounted by four locks from 21 ft. to 29 ft. in lift. Succeeding this there is a fall of 659 ft. to the St. Lawrence River, necessitating twenty-three locks from 5 ft. to 50 ft. in range. The intention is to provide a waterway 22 ft. deep, to accommodate lake boats 600 ft. long, 60 ft. beam, and 20 ft. draught. The estimated outlay is 100,000,000 dollars, and the work of construction will probably take ten years to complete. The canal project will materially alter the regimen of the Ottawa River, which forms the major portion of the route. At present it is a series of deep and wide basins, connected by narrow passages, which are broken by falls and heavy rapids. For the purpose of lockage, the falls are to be concentrated and all the small rapids eliminated. The forty-five dams required for the regulation of navigation (eighteen are of considerable size) will serve to concentrate the water-power at certain points, and it is computed that nearly a million horse-power will thereby become available, though possibly not more than 150,000 h.p. at minimum flow could be developed under existing conditions.

THE "Wellcome Photographic Exposure Record and Diary" for 1919 is issued by Messrs. Burroughs Wellcome and Co. as usual. Those who are in the habit of using this pocket-book will probably be surprised to find that the exposure calculator is improved, so that when set it shows the exposure required for all the ordinary apertures of lenses instead of one only, and that this is facilitated by printing the figures in different colours. The diary, the space for classified exposures, and the pages for notes and memoranda remain as before, while the tables of the sensitiveness of the various plates and papers on the market and the general information on photographic procedure are brought up to date. The book is a model of compactness and usefulness.

OUR ASTRONOMICAL COLUMN.

SCHORR'S COMET.—The following continuation of the ephemeris of this comet, for Greenwich midnight, is from the elements given in NATURE for December 19, 1918:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Jan. 2	3 57 47	13 45		
6	3 58 20	14 3	0·4015	0·2390
10	3 59 16	14 22		
14	4 0 33	14 41	0·4144	0·2751
18	4 2 13	15 0		
22	4 4 12	15 19	0·4271	0·3104
26	4 6 22	15 38		
30	4 8 53	15 57	0·4394	0·3448

Magnitude 15.

The following observations have been received:—

G.M.T.	R.A. h. m. s.	N. Decl. ° ′ ″	Observer	Observatory
Nov. 29·8297	4 7 37·6	11 47 47	Burton	Washington (Naval)
30·6602	4 7 4·2	11 49 47	"	" "
30·7466	4 6 59·5	11 49 56	Barnard	Yerkes

BORRELLY'S COMET.—This comet was observed by Mrs. Freeman with a 3-in. telescope on December 23. It is now growing fainter, but should be observable until the end of January:—

Ephemeris for Greenwich Midnight.

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Jan. 5	6 41 18	60 19	0·1776	9·7803
9	6 36 45	62 3	0·1825	9·8026
13	6 32 34	63 20	0·1876	9·8256
17	6 29 43	64 30	0·1930	9·8488
21	6 27 27	65 16	0·1984	9·8717
25	6 26 38	65 48	0·2041	9·8947
29	6 26 50	66 7	0·2098	9·9171

"THE COMPANION TO THE OBSERVATORY, 1919."—This useful work of reference is similar in form to recent issues. In addition to a summary of data from the Nautical Almanac, it contains Mr. Denning's list of meteor radiants for every night of the year, and ephemerides of variable stars classified into five types (Long Period, Algol, β Lyræ, Cluster, and Cepheid). The pages on double stars are due to Mr. Jonckheere; he gives recent observations of 128 pairs and ephemerides for 44. There are several tables of astronomical constants. The magnetic elements for Greenwich direct our attention to the increase in the rate of change in the westerly declination. It is now diminishing at the rate of 1° in six years, and should reach zero about the end of the century.

A misprint on p. 7 may be noted. The dates of planetary quadrature and station are all printed a line too high, opposite the wrong planet's name.

REDETERMINATION OF THE ORBIT OF 588 ACHILLES.—Mme. Julie M. Vinter Hinsen undertook the rediscussion of the observations of this number of the Trojan group made during the decade succeeding its discovery in 1906 (Copenhagen Observatory Publications, No. 29). Some trouble was caused by the fact that the object observed in October, 1914, proved not to be identical with Achilles. Omitting this, all the remaining normal places could be satisfied with no errors exceeding 6″. The following is the final orbit:—

Epoch and Osculation 1907 May 28 Berlin Mean Noon.

$$M = 84^\circ\ 3'\ 1{\cdot}9''$$
$$\left.\begin{aligned}\omega &= 125^\circ\ 36'\ 22{\cdot}4''\\ \Omega &= 315^\circ\ 35'\ 58{\cdot}5''\\ i &= 10^\circ\ 18'\ 13{\cdot}7''\end{aligned}\right\}1910{\cdot}0$$
$$\phi = 8^\circ\ 36'\ 13{\cdot}1''$$
$$\mu = 295{\cdot}96333''$$
$$\log a = 0{\cdot}719179$$

THE MANCHESTER EXHIBITION OF BRITISH SCIENCE PRODUCTS.

ON Thursday, December 26, there was opened without ceremony, in the Municipal College of Technology, Manchester, a replica of the British Scientific Products Exhibition held in August and September last in King's College, London, under the auspices of the British Science Guild. The London exhibition attracted much attention and commanded a large attendance of the public interested in the progress of applied science in the United Kingdom, especially as a result of the circumstances induced by the war. It proved that much had been accomplished despite unfavourable conditions as to the supply of certain products, some of them of prime importance, inasmuch as they rank as "key" products upon which certain great industries depend for their successful prosecution.

It was felt that the exhibition should be brought right to the centre of the great manufacturing areas of the country, and at Manchester a committee was formed under the presidency of the Lord Mayor with this intention. A guarantee fund was raised from manufacturers and others to meet the necessary expenses of organisation and equipment. The Education Committee willingly granted the free use of the spacious and convenient rooms and corridors of the College of Technology for the display of the exhibits, and every facility was afforded by the executive committee of the British Science Guild with the view of inducing the exhibitors at King's College to exhibit at Manchester.

The total number of firms contributing to the present exhibition is about two hundred and forty, including some sixty which did not make any display at King's College. These are chiefly textile firms and firms engaged in the manufacture of chemical or special engineering products. At Manchester, as might be expected, there is a specially fine show of dyestuffs and of intermediate products necessary for their manufacture, together with a fine exhibit of British-made synthetic indigo, the most important of all dyestuffs. Along with these is shown a fine display of goods dyed and printed therewith. There is also an excellent show of magnetos, exhibiting their dissociated parts, with specimens of the raw materials used, and arrangements are made to run the magnetos so as to show the ignition sparks produced for engines with various numbers of cylinders. The manufacture of these appliances, previously almost entirely in German hands, has been greatly stimulated by the requirements of the war, which has, without doubt, resulted in the establishment in this country of a highly essential branch of industry. The exhibition also includes an extensive display of gas- or oil-fired furnaces for hardening high-speed steel, for testing refractory materials, or for forging.

In the large hall of the college is displayed a standard Avro aeroplane, on which 40,000 pilots have been trained. It was the first machine to make a long-distance raid in Germany—Friedrichshafen, November, 1914—and the first to bring down a Zeppelin. Some beautiful specimens are shown of cotton-pile fabrics in successful imitation of Lyons silk velvets, and of printed cotton voiles and cretonnes and dyed cotton-threads. There is an extensive and typical collection of fine chemicals, and also of intermediate products used in organic syntheses for dye manufacture and for explosives. Some interesting chemical products are also shown prepared in the laboratories of the University of Birmingham according to the specifications of certain German patents or modifications thereof suitable for use as high explosives. The "Flatters" method of water colloid doping is shown as applied to gas-proof cloths and to aeroplane-wing cloths, together with micro-photographs illustrating the "permeability" of the acetate cellulose method as compared with the water colloid method of treatment. There is an excellent display of aluminium, showing its preparation from the ore to the finished material and its application to various uses, including automobile parts of all kinds and aeroplane parts, together with electrical equipment, with bare and insulated cables, bus-bars and feeders, traction motor and lifted magnet windings, etc.

Precision machinery and measuring instruments and gauges to a high degree of accuracy are strongly in evidence, together with pressure gauges, aeroplane-radiator thermometers—many thousands of which were made during the war by women labour—and optical pyrometers for measuring temperatures of from 700° to 4000° C., formerly made exclusively in Germany, but manufactured in this country since 1914. A notable exhibit is that of accelerine (paranitrosodimethylaniline), a powerful catalyst of the vulcanising process, the effect of which was discovered in 1914 by S. J. Peachey, working in the laboratories of the College of Technology, Manchester. The addition of 0·3 to 0·5 per cent. of the weight of the material to a rubber mixing reduces the time of vulcanisation to one-third of the normal, and it is now being used by many of the largest rubber and cable works. Examples are shown of six-score "Diatrine" paper-insulated and lead-sheathed cable suitable for a working pressure of 11,000 volts, provided with Glover's patent test sheath. There is also an exhibit of acid-resisting materials and vessels so necessary to meet the urgent demand which arose during the war for these indispensable requirements. The War Office Aircraft Fabrics Department of Manchester displays aircraft and kite-balloon fabrics and apparatus for testing the permeability of aircraft fabrics.

Interesting exhibits are also to be found illustrating various physical apparatus, such as polarimeters, wave-length spectrometers, Hilger vacuum spectrographs, aero-tensionmeters for the accurate and rapid measurement of the tautness of doped and varnished fabrics for aeroplanes, projection comparators for the rapid testing of screw-threads, together with examples of photographic micro-scales and graticules made by grainless, filmless, ceramic, and metallic deposition methods, as well as other forms of micro-scales, which were before the war a German monopoly, and a series of colour-films for scientific and technical purposes.

The catalogue includes, by permission of the British Science Guild, the various valuable scientific and technical articles prepared by recognised authorities which appeared in the London exhibition catalogue, and added considerably to the value of it. In addition, a chapter is devoted to recent researches by the staff and advanced students of the College of Technology, which cover a wide range of subjects, including many investigations required for naval and military purposes which have been found to be "of extreme value." In the electrical engineering department researches have been carried out under the auspices of the Institute of Electrical Engineers on the electrical and mechanical properties of porcelain and on the electrical properties of oils. Experimental work has been successfully completed upon a wattmeter for very heavy alternating currents, and a research concluded upon the existence or non-existence of an action between masses analogous to mutual induction between electrical circuits. The experiment showed that if any such action did occur, the ratio of the change of momentum in the body acted upon to the change of momentum of the acting body was less than $4{\cdot}3\times10^{-10}$. The paper excited considerable interest at the meeting of the British Association in 1915. Investigations were conducted upon the eddy current losses occurring in the end plates of turbo-generators, and a formula deduced by which these currents could be estimated. Many important commercial applications have resulted from researches upon the commutation of continuous-current generators and rotary converters. The municipal and sanitary engineering department has been engaged upon matters relating to the heating and ventilation of buildings, upon the design, construction, and use of material for artisans' dwellings and on town-planning matters, and upon experiments on the strength of lead and other pipes used for the distribution of water.

In the chemical department experiments have been undertaken on the sulphonation of oils under the auspices of the Society of Dyers and Colourists, and a further investigation on the nitration of oils has been begun, and under the research scheme of the Institution of Electrical Engineers work is now being done concerning insulating oils. The study of the chlorination products of rubber, one of which, known as "duroprene," is remarkable for its resistant and other properties, has been taken up. Research on fuels has included: heating by gas, the stripping of coal-gas, the distillation of cannel and other coals, as well as exhaustive examinations on certain products obtained from coal-mines, and also upon a series of seams of Lancashire coal. The conditions of carbonisation of iron, especially in case-hardening; the influence of impurities on the strength and on the resistance to corrosion of cast-iron; the influence of sulphur in the processes for making malleable iron castings, and on the toughening of copper and increasing the strength of copper alloys, have all been the subject of investigation and experiment with valuable results which have found industrial applications, whilst research on cellulose subsidised by the Department of Scientific and Industrial Research has also been in progress.

In the department of printing and photographic technology investigations were carried out, and are still proceeding, on the development of machine-printed photogravure, and much attention has been paid to new methods for the production of lithographic printing surfaces in monochrome and colour.

Much other research has been carried out or is in progress on the economic use of fuel, on air pollution, on gas flames, on the economic use of electricity for heating purposes, on fibre testing, and on the use of ramie waste for gas-mantles.

All the departments of the college have throughout the period of the war been busily engaged on investigations in aid of the requirements of the several departments of the Government. The results of some of the researches engaged in are shown in the space allotted to the college at the exhibition. It is to be hoped that the exhibition so happily inaugurated in London will serve to convince the public that British science intelligently applied can, if we so will it, contend successfully with the best efforts of the most highly educated of foreign nations.

THE CONCEPTION OF THE CHEMICAL ELEMENT AS ENLARGED BY THE STUDY OF RADIO-ACTIVE CHANGE.[1]

If a chemist were to purify lead from silver, and found on re-examining the lead that silver were present, and if, again and again, silver, initially absent, reappeared, the doctrine of the unchangeability of the elements would be at an end. The conclusion in 1902 by Sir Ernest Rutherford and myself with regard to the element thorium was of this direct and simple character. As often as the constituents responsible for the radio-activity are separated by physical or chemical means, they reform. One of the constituents, the thorium emanation, is a gas which was shown to possess the complete absence of chemical character characteristic of the argon family of gases. It is formed from thorium through the intermediary of another constituent, thorium-X, which is left in the filtrate, when a solution of thorium is precipitated by ammonia, but not by other chemical reagents. In turn the emanation changes into non-volatile products causing the active deposit. The clear conception of the nature of chemical change, the distinction between atoms and molecules, which we owe to the founders of chemistry, made it possible to recognise radio-active change almost instantly as a case of spontaneous transmutation. Novel as the explanation was, the phenomena explained are so novel as to transcend what to a generation ago would have appeared as the limits of the physically possible. But even to-day it is only in radio-active phenomena that the limits reached long ago in the chemical analysis of matter have been overstepped, and the rubicon, which many have vaulted over so lightly in imagination, has actually been crossed by science.

The first phase of the study of radio-active change was mainly concerned with the disentanglement of the long and involved sequence of transformations which, starting from uranium and thorium, were ultimately found to include all the known radio-elements. Beyond the fact that the radio-elements were in present course of evolution, it added little to the conceptions of chemistry. But in the second and more recent phase—concerned with the chemical character of the successive products, the law connecting this with the type of ray expelled in the change, the discovery of elements with unique radio-active but identical chemical and spectroscopic character, the identification of these as isotopes, or elements occupying the same place in the periodic table, the interpretation of the latter and the recognition that the so-called chemical elements are in reality heterotopes, or substances occupying different places in the periodic table, and are not necessarily even homogeneous—conclusions, not merely novel, but upsetting, have been reached.

The criterion at first relied upon in the analysis of matter into its elements, the possession of a unique chemical character, was added to by Dalton's atomic theory, which gave to each element a unique atomic weight. The periodic law apparently connected these two criteria, fitted the individual elements into families, and showed that, whatever the elements were, they were all of a class, the limits of chemical analysis, and, if complex, then all of the same kind of complexity. The periodic law introduced a third criterion of the element, that it occupied a place to itself in this scheme, and the discovery of spectrum analysis, a fourth, that it possessed a unique spectrum. The discovery of radio-activity introduced a fifth, the possession of a unique radio-active character, in the case of the radio-elements. Of the first three new elements discovered by the aid of the fifth criterion, polonium, actinium, and radium, the claim of the last to the title of element was brilliantly substantiated by the successive determination of its unique spectrum, unique chemical character, unique place in the periodic table, and unique atomic weight. The production of this element from uranium through the intermediary of ionium, and the production of helium from radium, and, in due course, from the other radio-elements, furnished conclusive proofs of the correctness of the first interpretation of the transmutational character of radio-active change.

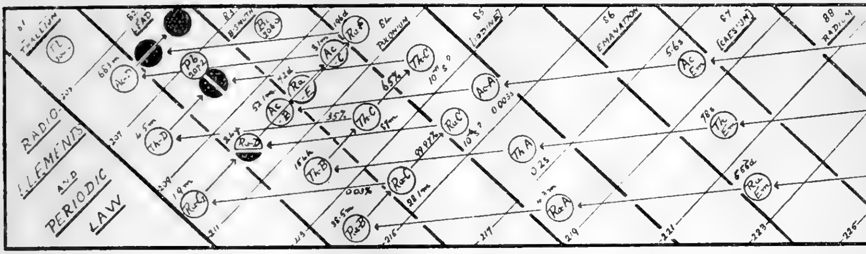
Then came a totally new departure. The possession of unique radio-active character does not always, as in the case of radium, connote unique chemical and spectroscopic character. As, one after another, the various members of the disintegration series were distinguished, by their breaking up in characteristic ways at definite rates, no further *chemically new* elements were found. All resembled known elements so closely that they could not be separated by chemical analysis, and those actually at work on these substances came to the conclusion that the chemical resemblances amount to identity. Radio-thorium is, for example, identical chemically with thorium. It was isolated from thorium and individually recognised by Sir William Ramsay and O. Hahn only because it is

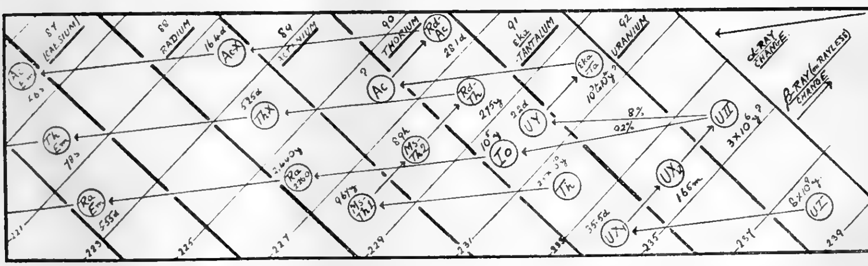
[1] Summary of a lecture delivered to the Chemical Society, December 19, 1918, by Prof. Frederick Soddy, F.R.S.

formed from thorium through an intermediate product, mesothorium, chemically different from thorium, but chemically identical with radium. No more elegant addition, not merely to knowledge, but also to the means of winning knowledge, can be imagined. Two separate substances, radio-thorium and thorium, in the original analysis of the thorium disintegration series, taken for one, become individually knowable, because the first is formed from the second through a third substance chemically totally distinct from either. Radio-active change thus furnished a new means of analysis, for which, outside the radio-elements, there is as yet no equivalent.

Further work on the chemical character of the various members of the disintegration series, notably by Fleck, who showed that practically all were chemically identical either with some common element or other radio-element, in 1913 paved the way for the generalisation independently arrived at by Russell, Fajans, and myself, which is brought up to date and illustrated by the accompanying figure. Each α-ray change was found to cause a shift of two places in the periodic table in one direction, and each β-ray change a shift of one place in the other, the first change being accompanied by a reduction of four units of atomic mass, a helium atom being expelled, and the second not involving a sensible loss of mass. Thus the successive places in the periodic table were first associated with unit variation of atomic charge, for the β-particle is the negative electron, and the α-particle a helium atom carrying two positive atomic charges. The elements with identical chemical character were found to occupy the same place in the periodic table, and were, therefore, termed isotopes. Conversely, the elements recognised by chemical and spectroscopic analysis may be termed heterotopes.

In the figure, which is to be read at 45°, the numbers at the head of each place—92 for uranium, and so on—are the atomic numbers, or number of the place in the complete list of places in the periodic table, as determined by Moseley, on the assumption that the atomic number of aluminium, the thirteenth element in the list, starting from hydrogen, is 13. The period of average life of each member is shown above or below its symbol, a "?" indicating that the period is indirectly estimated from the range of the α-ray expelled. The last member to be added, eka-tantalum or proto-actinium, the direct parent of actinium in an α-ray change, was discovered this year independently by Cranston and myself, and by Hahn and Meitner. For this element, for actinium, and for polonium, but for none of the others, are the criteria of unique spectrum and chemical character, as found for radium, to be expected. Moreover, the period of eka-tantalum, as estimated from the range of its α-rays by Hahn and Meitner, makes it appear that in due course determination not only of the spectrum, but also of the atomic weight and complete chemical nature, of this element will be possible. It is only in this way that the open question whether the actinium series branches off as shown at uranium-II or at uranium-I can be settled.





As the figure shows, so far as the changes have been followed, they all result in the production of isotopes of lead ranging in atomic weight from 206 to 210, the main products being that of uranium, 206, and both thorium products in the two branches, 208. The conclusion that lead was the ultimate product of thorium was new, but the prediction that the ultimate products of both uranium and thorium are different isotopes of lead—the one with an atomic weight less, and the other with an atomic weight greater, than that of common lead, 207·2—has been completely confirmed by experiment, and it has also been shown that ionium has an atomic weight lower than thorium (compare NATURE, July 19 and 26, 1917).

The older chemical analysis of matter distinguished only heterobaric heterotopes. The newer methods depending on radio-active change distinguish, not only heterobaric, but isobaric isotopes, and also isobaric heterotopes—that is, substances of different atomic weight and identical chemical character, of the same atomic weight and chemical character, and of the same atomic weight and different chemical character. A glance at the chart will show many examples of all three kinds. Not only has the chemical element been robbed of its time-honoured title to be considered the ultimate unchanging constituent of matter, but its title to be considered homogeneous has also vanished. The century that began with Dalton and ended with the discoveries of Becquerel and the Curies took the practical conception of the element it found extant, as that which could not be further resolved, and made of it the central conception of a theory of the ultimate constitution of matter. The element was first atomised, and then the atom and the element became synonyms, related as the singular is to the plural. Every one of the conceptions which associated the atom with the chemical element now has to be modified. Atoms of different chemical elements may have the same atomic weight; those of what the chemist and spectroscopist regard as the same element may have different atomic weight; and, most difficult to include of all to anyone to-day attempting to define the chemical element, even though the atoms all have the same weight, the element, nevertheless, may be an unresolvable mixture of fundamentally different isobaric isotopes. Present-day complete identity may conceal differences for the future of paramount importance, if ever transmutation is practically realisable at will. The goal that inspires the search for the homogeneous constituents out of which the material world is composed is now known to be, like infinity, approachable rather than attainable. The practical and necessary conception of the chemical elements, as understood before these discoveries, is, of course, unaffected. It had, and it has, a real significance as representing the limits of the spectroscopic and chemical analysis of matter, which remains, though it is now known to convey something very unlike the original and natural conception of the elements as the *l m n*'s of the material alphabet.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE following candidates have been elected to represent University constituencies in the House of Commons (members of the late Parliament are distinguished by an asterisk):—*Oxford:* *Lord Hugh Cecil and *Mr. R. E Prothero. *Cambridge:* *Mr. J. E. P. Rawlinson and *Sir Joseph Larmor. *London:* *Sir Philip Magnus. *Combined English Universities:* *Mr. H. A. L. Fisher and Sir Martin Conway. *Wales:* *Mr. J. Herbert Lewis. *Scotland:* *Sir Watson Cheyne, Mr. D. M. Cowan, and *Sir Henry Craik. *Dublin:* *Mr. A. W. Samuels and Sir Robert Woods. *National:* Mr. J. MacNeil. *Queen's (Belfast):* Sir William Whitla.

THE National Education Association, Caxton House, Westminster, has prepared and published a useful summary of sixteen quarto pages (price 6*d.*) of the Education Act, 1918, in which the Act is succinctly summarised and explained. The pamphlet further contains a brief *résumé* of each of the sections of the Act, in which is included only the operative words and phrases grouped under special headings, such as the "Organisation of Education," "Co-operation and Combination," "Expenditure," "Attendance at Continuation Schools," "To Aid Research," "Central Schools and Classes," "Education Grants," etc. It will prove exceedingly helpful to members of education committees, to officials engaged in administration, and to the teaching profession, both public and private, since it gives without technical and legal verbiage a clear view of the operations of the Act, and enables them to see how very much of the Act can, even in present circumstances, be brought into immediate operation. Now that the war is practically over it may be assumed that the Board of Education, as it is empowered by the Act, will, so soon as the conditions of peace are arranged and the treaty is signed, bring into operation the vital sub-sections of the Act raising the compulsory age of attendance at public elementary schools to fourteen years in all areas, and empower local authorities to raise by by-law the age to fifteen where so desired. Already a majority of the sections of the Act is in full operation, and it only awaits the conclusion of peace for this, the most important Act of the last session of Parliament, to come into full and salutary effect.

IT has been known for some time that, by reason of the general interruption of academic studies during the war, special and temporary provision would be made for the admission of men of military age into the Civil Service otherwise than by competitive examination. Announcement is now made that appointments within the scope of clause 5 of the Principal Order (the Civil Service (Consolidating) Order, January 10, 1910) may be made by selection on a competitive basis, but without competitive examination, through the agency of a selection board or boards appointed by the Treasury, and according to regulations framed, or to be from time to time framed, by the Commissioners, and approved by the Treasury. All men who have served either in his Majesty's Naval, Military, or Air Forces, or, being unfit for general service in those forces, have been employed in one or more of his Majesty's Civil Departments during the war, and are in a position to satisfy the Commissioners and the Selection Board that they are of the requisite age, health, character, and educational and other qualifications, will be eligible to compete for such appointments. It is understood that the Selection Board to be appointed by the Treasury will be charged with the work for India and the Colonies, as well as for the Home Service. It is very important that these Selection Boards shall include representatives of scientific and other modern subjects, as well as those with literary or legal interests, so as to ensure that a just proportion of the candidates appointed shall possess the training and knowledge which a progressive nation needs in its administrative officials.

IN the *Scientific Monthly* for September Prof. George Sarton has an article on "The Teaching of the History of Science," which gives further insight into his ideas on this subject. Just as a skilled workman employed day by day on the one job he can do best runs the risk of becoming a human machine, so the scientific investigator who devotes his life to one particular field of research is in danger of losing touch with reality. The workman may gain a broader outlook over the work on which he is engaged by attending evening classes at a technical institute; for the scientific investigator Prof. Sarton recommends lectures on the history of science. The lecturers on this subject would give comprehensive surveys of the whole field of science, illustrating their lectures, so far as possible, with models and simple experiments. The author considers that each university should establish three such courses:—(*a*) An introductory course on the history of science throughout the ages; (*b*) the history of a particular science; and (*c*) the history of science and civilisation at a special period. The two special courses would be changed from year to year. He would admit to these courses only those who, by having worked successfully in a laboratory, would be in a position to appreciate the instruction. Prof. Sarton insists that the value of this teaching will largely depend upon the soundness of its scientific foundation. The teaching should not be entrusted to literary people, philosophers, or anyone knowing science only in a superficial way, but must be precise and concrete, its chief purpose being to interpret the scientific spirit and methods. The ultimate aim of the courses is to humanise science, and so to give it its due part in a general scheme of education.

SOCIETIES AND ACADEMIES.

LONDON.

Optical Society, December 12.—Prof. F. J. Cheshire, president, in the chair.—Instructor-Com. T. Y. **Baker** and Major L. N. G. **Filon**: An empirical formula for the longitudinal aberration of a ray through a thick lens. The authors showed that the development of the longitudinal aberration as a power series is frequently illegitimate owing to its divergence for comparatively slight inclinations of the rays. Instead of such development of the form $at^2+bt^4+\ldots$, where t is the tangent of the inclination of the ray, they proposed a formula $At^2/(1+Bt^2)$, and determined A and B numerically from the values of the aberration of particular rays calculated trigonometrically through a lens. This was done for a whole series of image positions and for a whole series of lenses of different shapes but of the same focal length. The numerical values of A and B so obtained were then analysed, and an endeavour was made to obtain approximate general formulæ for them in terms of the image position and the lens shape. The authors decided that in all cases the value A in their empirical formula and the value a in the power series were practically identical. The value of a was given by the authors in a paper read before the society in May. The value of B can be expressed as a cubic in M, the linear magnification of the image. Thus $B=B_0+B_1M+B_2M^2+B_3M^3$, in which the four coefficients B_0, B_1, B_2, and B_3 are all quadratic functions of the mean curvature of the lens faces.—Major E. O. **Henrici**: Spirit-levels. The best bubble tubes for spirit-levels have been made in Germany; it seems desirable that an investigation should be made of the factors necessary for producing satisfactory tubes. The advantage of a long air-bubble, as regards both the accuracy and rapidity with which the bubble comes to rest when displaced, was pointed out, and also the advantage of a short radius of curvature as regards the latter point. The radius of curvature (in other words, the sensitiveness) must, however, be sufficiently great for the bubble to move noticeably with the smallest angular tilt of the tube which it is desired to indicate. If the bubble be too sensitive, time is lost; if it be not sufficiently sensitive, a spurious idea of accuracy is given; the sensitiveness of every bubble tube for accurate work should be marked. The methods of mounting, illuminating, and viewing the bubble tube frequently leave much to be desired, and improvements in these matters lead to increased accuracy for a given sensitiveness. Several methods of viewing by means of prisms were described, the most satisfactory known to the author being one placed on the market by Zeiss. The accuracy of shaping the surface required in a sensitive bubble is very great. If a tube has a corrugated surface, the corrugations having an amplitude of 1/2000 mm. and a period of 10 mm., the angle of tilt to move the bubble 1 mm. may vary 38 per cent. from its nominal value in the case of a bubble with a sensitiveness of 10 seconds per mm., the bubble being 35 mm. long. A similar corrugation with a 2-second bubble will make it almost useless for any purpose. Further investigation is required into the effect of the following factors on the performance of the bubble:—Quality, polish, and cleanliness of the glass; quality and purity of the liquid and vapour in the tube, and the best methods of mounting and viewing.

Aristotelian Society, December 16.—Prof. Wildon Carr, vice-president, in the chair.—Prof. J. **Laird**: Synthesis and discovery in knowledge. The paper consisted of a discussion of two sharply contrasted views of knowledge (viz. that knowledge is essentially the inspection or the discovery of an object which is given or revealed, and that knowledge is essentially a process of organisation or construction on the part of the mind), together with a consideration of certain hypotheses designed to mediate between these extreme views. The general argument was that while the first of these alternatives could be defended against many of the objections commonly brought against it, it was ultimately inadequate, since representative construction in words, images, etc., is plainly an integral part of most varieties of knowing. An examination of the theory that knowledge is always the inspection of a construction showed (1) that in this case the product of construction required to be apprehended directly, and (2) that such a product could be known to be representative only if the things represented were directly apprehended, in some instances at least. The theory that knowledge consists of construction (it was claimed) was therefore refuted, and the rest of the argument consisted of a detailed investigation into the truth of the statements that the object of knowledge is always (in some sense) a mental product on the ground that this object is always "a unity" or "a meaning," or that mental imagery is always an essential part of it. The author maintained that these arguments were either fallacious or inconclusive.

PARIS.

Academy of Sciences, December 9, 1918.—M. P. Painlevé in the chair.—E. **Picard** and A. **Lacroix**: The second meeting of the Inter-Allied Conference of Scientific Academies. An account of the resolutions passed at the meeting held at Paris, November 26 to 29 (see NATURE, December 26, 1918, p. 325).—J. **Drach**: Integration of a partial differential equation of the dynamics of fluids.—A. **Buhl**: The extension to multiple integrals of the theorem concerning the exchange of the amplitude and parameter in hyperelliptic integrals.—A. **Lambert**: Certain polynomials connected with Laplace coefficients.—Ch. **Frémont**: A new machine for measuring the resistance of cast-iron by the method of chiselling.—Ch. **Gorceix**: The probable correlation of the displacements of level of the base and the oscillations of glacial fronts.—A. **Guébhard**: A possible conciliation between the two theories of volcanic action.—M. **Molliard**: The saprophytic life of an Entomophthora. This fungus (*E. henrici*), developed originally on a *Culex pipiens*, has been grown successfully on the sterilised grub of *Euchelia jacobaeae*, on sterilised ox-liver, and even on carrot, but in the last-named the cultures are not so abundant as on liver. Hence this species is not necessarily parasitic.—F.-X. **Skupienski**: Sexuality in *Dictyostelium mucoroides*.—L. **Roule**: The state of spawning salmon during their migration into fresh water in France. From the examination of eighty fish taken at different periods it is concluded that for the first two years young salmon live in fresh water, and then descend to the sea, growing there for a period varying from two to four years. Then, at the age of between four and six years, they return to fresh water for reproduction.—M. **Caullery** and F. **Mesnil**: The initial parasitic phases of *Xenocoeloma brumpti*. Observations on this parasite in various stages of development confirm the interpretation, apparently paradoxical, deduced from the study of the adult.—E. **Roubaud**: Physiological rhythms and spontaneous flight in *Anopheles maculipennis*.—F. **d'Hérelle**: The *rôle* of the filtering bacillus in dysentery. This bacillus exists normally in the intestine. The presence of the Shiga dysentery bacillus in the intestine determines at first a considerable increase in the activity of the filtering bacillus against *B. coli*, and then it becomes capable of causing the gradual or rapid disappearance of the Shiga bacillus. It has been further proved in the case of the rabbit that cultures of the filtering bacillus have preventive and curative action in the disease introduced experimentally.—A. **Vernes** and R. **Douris**: The action of ferric thiocyanate on normal human serum.

December 16, 1918.—M. P. Painlevé in the chair.—M. **Hamy**: The diffraction of solar images.—Ch. **Depéret**: An attempt at the general chronological coordination of the Quaternary period.—M. A. Rateau was elected a member of the division of the application of science to industry, M. Waddell a correspondant for the section of mechanics in succession to the late M. Zaboudski, and Sir David Bruce a correspondant for the section of medicine and surgery in succession to the late M. Czerny.—M. **Valiron**: The general properties of entire functions and the theorem of M. Picard.—M. **Mesnager**: Curves defined by series. Advantages of a change of definition.—M. **Swyngedauw**: The effective resistance and reactance of an armoured triphase cable for the three harmonics of the current.—G. A. **Le Roy**: A mode of mercurial embalming in medieval times. The examination of a material used in embalming John of Lancaster, Duke of Bedford, in 1435 proved it to consist of balsams triturated with metallic mercury.—J. de **Lapparent**: The elaboration of silica and siliceous limestones by algæ of the Girvanella group.—Mme. Valentine Charles **Gatin**: The structure of the peduncle in the flowers of Liliaceæ. The anatomical structure of the floral peduncle in the Liliaceæ forms an anatomical distinction between the different genera of this order, as well as the species of the same genus.—G. **André**: Distribution of the mineral elements and the nitrogen in etiolated plants. About three-fourths of the nitrogen and phosphoric acid present in the seed (haricot) are transferred from the cotyledons to the young plant during twenty-five days' growth in the dark. The redistribution of the sulphur is similar.—J. **Chaine**: Considerations on the general muscular system of the vertebrates.—Ch. J. **Gravier**: The adaptation of the foot to the surrounding medium in the sea anemone at great submarine depths.—MM. **Alezais** and **Peyron**: The characters and origin of a group of tumours wrongly classified with the coccygian class of Luschka. The authors give reasons for regarding these so-called peritheliomas as neoplasts of neuro-epithelial origin arising from vestiges of the caudal segment of the spinal column.—M. **Heitz-Boyer**: The osteogenetic action of dead bone tissue.

BOOKS RECEIVED.

Electro-analysis. By Prof. E. F. Smith. Sixth edition. Pp. xiii+344. (Philadelphia: P. Blakiston's Son and Co.) 2.50 dollars net.

The Botany of Crop Plants. By Prof. W. W. Robbins. Pp. xix+681. (Philadelphia: P. Blakiston's Son and Co.) 2 dollars net.

The Natural Organic Colouring Matters. By Prof. A. G. Perkin and Dr. A. E. Everest. (Monographs on Industrial Chemistry Series.) Pp. xxii+655. (London: Longmans, Green, and Co.) 28*s*. net.

Evolution and the Doctrine of the Trinity. By S. A. McDowall. Pp. xxvi+258. (Cambridge: At the University Press.) 9*s*. net.

Technical Handbook of Oils, Fats, and Waxes. Vol. ii.: Practical and Analytical. By Percival J. Fryer and Frank E. Weston. (The Cambridge Technical Series.) Pp. xvi+314. (Cambridge: At the University Press.) 15*s*. net.

The Physiology of Industrial Organisation and the Re-employment of the Disabled. By Prof. Jules Amar. Translated by Bernard Miall. Edited, with notes and an introduction, by Prof. A. F. Stanley Kent. Pp. xxv+371. (London: The Library Press, Ltd.) 30*s*. net.

A Text-book of Biology for Students in General, Medical, and Technical Courses. By Prof. W. M. Smallwood. Third edition, enlarged and thoroughly revised. Pp. xiv+306+8 plates. (Philadelphia and New York: Lea and Febiger.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

MONDAY, JANUARY 6.

ARISTOTELIAN SOCIETY, at 8.—C. D. Broad: Mechanical Explanation and its Alternatives.

TUESDAY, JANUARY 7.

RÖNTGEN SOCIETY, at 8.15.—Dr. H. S. Allen: Electrical Changes Produced by Light.

WEDNESDAY, JANUARY 8.

GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, JANUARY 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—M. B. Field The Navigational (Magnetic) Compass as an Instrument of Precision

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

THURSDAY, JANUARY 16.

CHEMICAL SOCIETY, at 8.

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

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Registered as a Newspaper at the General Post Office.]

THURSDAY, JANUARY 9, 1919.

OPTICAL RESEARCH AND DESIGN.

Simplified Method of Tracing Rays through any Optical System of Lenses, Prisms, and Mirrors. By Dr. Ludwik Silberstein. With diagrams. Pp. ix+37. (London: Longmans, Green, and Co., 1918.) Price 5*s.* net.

THERE are two criteria for estimating the value of Dr. Silberstein's latest work. On one hand it possesses great theoretical interest, yet on the other it lays claim to practical usefulness. One must attempt to do justice to both aspects.

From the theoretical point of view the author's suggestion for the tracing of rays through optical systems is deserving of the highest commendation. Progress in the application of mathematics to problems in physical science is largely bound up with the art of economy of symbolical and mental effort, by means of the employment of the briefest possible notation and the most powerful analytical processes. The introduction of the vector notation into geometrical optics is therefore an important step in advance, and Dr. Silberstein is eminently the man to bring this about. He has already done much to initiate English students into the methods of vector analysis, and to convince them of its merits as a tool for the discovery of new results, and as a medium for the brief formulation of discoveries both old and new. In particular he has published some beautiful results of the application of vector analysis to optical research. The latter portion of the present book is a sufficient vindication of the claims of vector methods, and there can be no doubt that they represent the most powerful yet devised for attacking problems on reflection and refraction at systems of plane surfaces.

The optical computer is, of course, interested in plane surfaces; his main task, however, consists in the tracing of rays through systems of spherical surfaces, generally coaxial. In the first half of the book the author develops on vectorial principles the theory of ray tracing through such systems, and here, too, the superior merit of the vector notation is made evident. One must nevertheless remark that his strictures on the old *transfer formulae* are not fully justified, for it is possible to represent the transfer by means of a comparatively short and simple set of equations, even without the aid of vectors.

When, however, we come to the consideration of the practical aspect of the question, some doubts arise as to the merits of the formulæ thus derived. It is a great pity that exact schedules for computation by logarithms or by the calculating machine are not included; they would have greatly enhanced the value of the book. Even one or two actual examples, worked out in full, would have been welcome. It may be that the arithmetical processes contemplated by the author do not justify the suspicion, but one cannot help wondering whether the number of table-entries required by his formulæ does not exceed that required by the well-known Seidel formulæ. Further, it has been pointed out to the present writer that Dr. Silberstein's method possesses the disadvantage of using the cosines of many of the angles. For small angles—and in optical systems most of the angles of incidence, refraction, and convergence are only a few degrees—cosines define the angles with very little accuracy. Thus in the case of angles of about 10° the sines are six times as accurate as the cosines, whilst logarithmic sines are about thirty times as accurate as logarithmic cosines. The further discussion of the vector method in the light of these two criticisms would be very desirable, and students of geometrical optics will welcome any further contributions from Dr. Silberstein's pen. S. BRODETSKY.

PETROL AND PETROLEUM.

(1) *Petroleum Refining.* By Andrew Campbell. With a Foreword by Sir Boverton Redwood, Bart. Pp. xvi+297. (London: Charles Griffin and Co., Ltd., 1918.) Price 25*s.* net.

(2) *Petrol and Petroleum Spirits. A Description of their Sources, Preparation, Examination, and Uses.* By Capt. W. E. Guttentag. With a Preface by Sir John Cadman. Pp. xi+135. (London: Edward Arnold, 1918.) Price 10*s.* 6*d.* net.

THE petroleum industry has developed enormously during the last few years, and processes of production and manufacture of products have so changed from the old "rule-of-thumb" methods which were in vogue in the early days that it is only natural for the literature on the subject to have increased in proportion. In the mass of literature in the English language which has been published on petroleum there has hitherto been no publication on petroleum refining, or one solely confined to petrol and petroleum spirits, both of which are of particular interest at the present time, when we are emerging from the throes of a world-war in which petroleum and its products have played such a prominent part.

Mr. Andrew Campbell, the author of "Petroleum Refining," is one of the pioneers of the British petroleum industry, and his views on the practical side of the subject are the outcome of experienced knowledge. It is rare that technical knowledge, experience, and clarity of diction are found together, but when so found they render the work of their possessor of inestimable value, and it is the possession of these qualities which is strikingly emphasised throughout Mr. Campbell's book.

The volume is divided into nine chapters as follows:—(1) Examination of the crude oil; (2) general departments; (3) storage of crude oil and liquid products; (4) distillation; (5) paraffin extraction and refining; (6) candle manufacture; (7) chemical treatments; (8) distribution of products; (9) engineering specifications; an appendix consisting of a bibliography of the literature (either published in English or of which extracts have been published in English) appertaining to petroleum refining, together with a name and subject index. The volume is also very well illustrated with 138 illustrations, which include twenty-nine folding plates and three diagrams, and it has eleven comparative tables.

Although in a short review full justice cannot be done to a work which is so full of information as this, yet a glance through the contents table shows its comprehensive character. When the design and erection of a refinery for the treatment of petroleum are projected it is very necessary that the fullest possible information with regard to the crude material should be obtained before anything further is done, and it is significant that the first chapter should deal with this branch. It contains a complete scheme with this end in view, which cannot fail to be of great use to all who are interested in the subject.

Without wishing unduly to criticise a chapter which is so full of necessary information, one would like to suggest that the portion dealing with "flashing points" and "colour" is somewhat too fully dealt with, as this branch appears in most text-books on petroleum, and belongs more to the testing of refined products than to the examination of the crude oil. Of special interest, however, is Fig. 30, giving the designs and arrangements for a five-gallon experimental still, and diagrams 1 and 3 of refining operations and yields of products.

The question of fire risks looms largely in the petroleum industry, and this subject is ably dealt with in chap. ii., which treats also of the departments necessary in refineries, apart from those necessary to actual refining operations. Chaps. iv., v., vi., and vii. discuss exhaustively the actual distillation, refining, and paraffin extractions, as carried out on the large scale, as well as candle manufacture, which in some refineries attains to large dimensions. The subject-matter of these chapters is exceedingly well handled, due stress being laid on the vital points which make for success in these operations, showing the mind of the man who is *au fait* with the general policy, as well as the detailed operations of the manufacture.

Chap. iv., on the subject of distillation, is well worthy of close study, embodying as it does all the up-to-date information available; and in this chapter also attention should be paid to the portion dealing with the question of heat exchange or conservation, as it behoves every oil-refiner to obtain the greatest possible yield from his oil, and by saving fuel a definite conservation results. In the chapter on chemical treatments one would have liked to see more attention paid to the manufacture of lubricants, which is only lightly treated, but is one of the more difficult of the refiners' problems. In this chapter is given a very complete description of the Edeleanu process, which to a large extent lessens the wasteful sulphuric acid treatment of oils. The engineering specifications given in chap. viii. will supply a long-felt want to the student, who so rarely has access to these essential details.

The book will undoubtedly become the standard work on the subject, and should be in the library of each and every person interested in petroleum.

(2) Petrol and petroleum spirits now play such an important part in the economic life of the nation that it is a matter for wonder that so little is known by the general public of their manufacture, constitution, and properties. In the work under notice Capt. W. E. Guttentag, who has had a unique experience in the last few years, has endeavoured to enlighten us, and has compiled quite a large proportion of the available knowledge on the question.

Capt. Guttentag would have been well advised to leave out of the book altogether chap. ii. on petroleum, (*a*) characteristics, (*b*) origin, (*c*) geological, (*d*) exploitation, (*e*) refining of crude oil, or to handle it much more fully than he has done, for the sketchy account which he has given is of little use to the serious student, and is only liable to give unbalanced ideas to the general reader. In any case, it would have been well through the whole of the book to give detailed references to original workers, for without these a technical work loses much of its value. An illustration of this, showing also how mis-statements creep into text-books and are copied and repeated until they are accepted as axioms, is the passage: "The bad smell of cracked spirits . . . is attributed to small quantities of sulphur and nitrogen compounds." This statement was first made by Rittman and then copied by Bacon and Hamor, whereas now it is a generally accepted fact that the smell of cracked spirits is due to that of the unsaturated bodies of the di-ene class which it contains.

The chief value of this work is in chap. v., which deals with the question of examination and testing both for routine and special work, in which the author has freely given of his special knowledge.

The book forms a useful little laboratory guide for those engaged in the testing of petrol.

WOOL INDUSTRIES.

Wool. By Frank Ormerod. ("Staple Trades and Industries." Vol. i.) Pp. xii+218. (London: Constable and Co., Ltd., 1918.) Price 6*s.* 6*d.* net.

THIS work covers in a general way the wool-growing and wool-manufacturing industries. More space is devoted to the sheep and to the wool trade than to the following manufacturing processes, but in no case can the treatment be considered exhaustive.

There are a few sins of omission and of commission which should be corrected in future editions of the work. For example, in dealing with the development of the wool comb on p. 31 no reference is made to the work of Isaac Holden; neither is there reference to the fact that Lister, in purchasing Heilman's English patent, was able to suppress the Heilman comb in Great Britain. It was not until 1900 that this comb, as made by the Société Alsacienne, reappeared in Yorkshire—then too late, some authorities think, to give the British manufacturer a chance in the short-combed French goods trade.

It is obvious that the author has not followed the interesting work of Prof. Ewart, of Edinburgh University, or he would not refer to the black-faced variety of sheep as being "as near to the original as any breed now existing." The University of Leeds about a year ago purchased a flock of Soay sheep simply to maintain them as a representative pure-bred flock of a type dating back to prehistoric times. The writer's statement that hair will not felt is obviously based on second-hand knowledge, which is not trustworthy; again, the idea that the serrations help to bind the fibres together has now been brought seriously into question. That worsteds will not felt was taught for years in our technical institutes, but thousands of pieces of worsted are now "milled" every day in the West Riding of Yorkshire alone.

There are men still living who have seen the sources of supply of fine wools change from Spain to Silesia and Saxony, and then from Silesia and Saxony to Australia; there are interesting evidences of the changes in the treatment here given to "The World's Wool Supply."

In dealing with "Preparation and Manufacture" the writer shows again a certain lack of grasp of fundamentals, as, for example, in explaining the difference between woollen and worsted, and in referring to healds and mails as "tiny loops of string." Again, on p. 125 it is stated that the needles in a Jacquard are acted on by holes, whereas they are acted on, *not* by holes, but by blanks. There is a serious error in printing the illustration of wool fibres facing p. 42. The block has evidently been turned round by the printers, with the result that the references are altogether misleading.

Having criticised the defects—which, all considered, are few—it is now the author's due that the excellences of the work should be emphasised. In many important respects the work is absolutely up to date. For example, the value of a suitable atmosphere in the spinning-room is interestingly treated. The harnessing of streams of water for power purposes is also referred to, although the author appears to be unaware of the method of electric control of water-power to attain that necessary steadiness in running otherwise unobtainable. As further illustrating the up-to-dateness of the work, reference will be found to the formation of the Agricultural Organisation Society for dealing with British wools on lines similar to those upon which Colonial wools are dealt with; to the use of a woven paper cloth for wool packing; to the development of the "automatic doffer" in the worsted spinning industry; and to the possibilities of the automatic loom in which weaving is done in the dark, any defect in the mechanism at once lighting up the loom, thus indicating the need for attention.

The psychology of the consuming public comes in for indirect attention, and the references to the trade guilds—which appear to be somewhat remarkably resuscitated in our present-day trade combines and trusts—and other matters of historical importance all tend to make the work very interesting as well as directly useful. Upon the whole, the work may be regarded as being among the best of the shorter general guides to the wool trade and the wool-manufacturing industries; its faults are few, and its excellences many.

OUR BOOKSHELF.

Winter Botany. A Companion Volume to the Author's "Plant Materials of Decorative Gardening." By Prof. W. Trelease. Pp. xxxii + 394. (Urbana: Published by the Author, 1918.) Price 2.50 dollars.

IN this handy and concise little volume Prof. Trelease describes the winter characters of 326 genera of trees and shrubs belonging to ninety-three families. With the exception of Larix and Taxodium, the Conifers are excluded, as these, being evergreen, have been adequately treated in the companion volume on "Plant Materials" issued in 1917. The book, though of American origin, includes most of the genera and species which the student is likely to find, wild or in cultivation, in this country, and should prove a useful handbook to the botanist who is interested in the determination of woody plants during the winter season. The generic description is in each case supplemented by a wood-cut illustrating the chief points to be observed, and by a brief key to the species which are likely to be found.

The descriptive matter is preceded by a key to the genera, and instructions are given as to its use. A good pocket-lens is essential to the examination of the characters of the twigs which is required for the use of the key. These characters include the position of the leaves, as indicated by the scars, the form of the scar, the position, number, and form of the buds and stipules (if present), the surface characters of the twigs, the form of the pith, and other easily observed internal characters. As heath-like and some other evergreen plants are included, the form and arrangement of the persistent leaves are considered in these cases. References are also given under the genus to descriptive works in which the winter characters of the plants in question are more fully treated. A useful glossary and a full index of Latin and popular names complete the volume.

The Illinois and Michigan Canal: A Study in Economic History. By Prof. J. W. Putnam. (Chicago Historical Society's Collection, vol. x.) Pp. xiii + 213. (Chicago: The University of Chicago Press, 1918.) Price 2 dollars.

THIS book was originally prepared as a doctoral dissertation of the University of Wisconsin. It is a mine of facts and a concrete illustration of the thesis that canals were a success when there were no railways, but are not a success when faced with the competition of modern railway transport. At the same time the success of this canal was an early indication that in the opening up of new lands the provision of adequate means of transport must precede the advent of the settler.

A connecting link between the Great Lakes and the Mississippi was necessary. An ancient outlet of Lake Michigan led to the Illinois River, which reaches the Mississippi near St. Louis, and so the State authorities, after overcoming many financial difficulties, eventually made the canal, which was opened in 1848.

Prof. Putnam details these early struggles, blames the "spoils system" for inefficient management and the consequent failure of the canal in later years, and pleads for the construction along the canal route of a waterway suitable for such ocean-going steamers as can at present reach Chicago and St. Louis. Both these cities have progressed in no small degree because they are terminals of the Illinois and Michigan navigation. Chicago in 1831 was a village; from 1848 to 1854 the population of the city rose from 29,035 to 74,500, and in 1870 it contained more than 300,000 inhabitants.

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.*]

Some Temperature Anomalies.

THE investigations conducted by Hann and others have yielded a complete explanation of the physical processes involved in the production of the Föhn, Chinook, and similar winds met with in various parts of the world—a warm, moist air current depositing its moisture and decreasing in temperature while ascending the windward slope of a mountain range, then on the lee side descending and becoming intensely dry and increasing greatly in temperature as a consequence of the increase of pressure during the descent. But in the British Isles, and no doubt in other regions similarly situated in the neighbourhood of a relatively warm ocean current, there are occasions—and they are by no means uncommon—when a mild, soft sea breeze produces some curious temperature anomalies, which, so far as I am aware, have not attracted the attention of meteorologists and physicists, and, consequently, are thus far without any adequate explanation. They visit this country and western Europe in all seasons, but they are more noticeable in the winter half of the year, because the change of temperature is then relatively much greater than in the normally warm seasons.

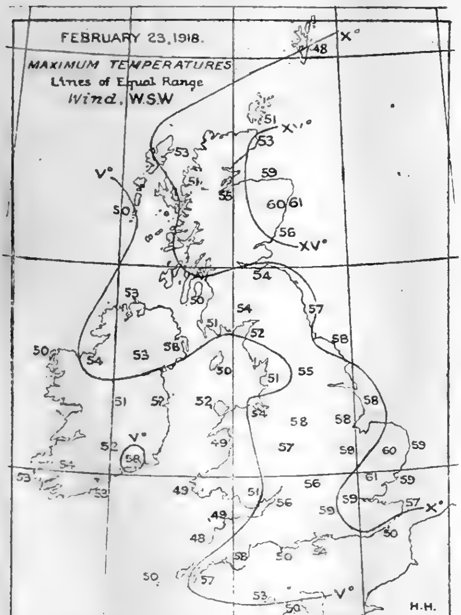
Although the feature is observed only with the wind from points between west and south, and perhaps most frequently from about W.S.W., it is far from being an invariable accompaniment of an air current from this direction. On theoretical grounds, and from our conception of the natural order of things, we expect a rise of temperature over this country with a wind coming from the warm region of the Azores and the Lower Atlantic—the increase greatest in the west, nearest the seat of the source of the warmth, then becoming less and less marked during the eastward translation of the air current across the land, so that the bracing east coast of Britain would still be markedly cooler than the west coast of Ireland. The remarkable fact, however, is that actually the exact contrary is the case, the arrival of the warm current producing an increase of temperature on the western coasts, but the increase becoming more and more decided over the cold land, until the temperature in the extreme east is considerably higher than it is on the western seaboard.

There is in the Meteorological Office publications—the Daily, Weekly, and Monthly Reports for many years past—an *embarras de richesses* of illustrations of this particular feature. An excellent example is afforded by our experience during February 23 of the past year. On the morning of that day we were placed between an anticyclone centred over the Bay of Biscay and low pressure extending across from Iceland to Norway, with the wind at W.S.W. from Shetland southward, and the air temperature already well in excess of the normal in all districts. Over the country generally the thermometer had remained as high as 45° to 51° through the preceding night. During the day, however, the rise of temperature was very slight in the west, while it increased decidedly with the eastward advance of the wind. In the accompanying map the afternoon maximum temperatures are seen to be below 50° along the shores of the Bristol and St. George's Channels, and 50° to 53° on the outer western coasts from the Hebrides down to Scilly. Over eastern Britain, on the other hand, the maxima were 58° and upwards, 60° being reached at Crathes and Geldeston, and 61° at Aberdeen and Halstead. These were about the same as the maxima registered at the Azores on previous days. Even in eastern Ireland 56° were registered in Down, and 58° in Waterford. The day's range of temperature was less than 5° in the west generally, 0° to 3° in several localities, but eastward it increased to more than 10° over the greater part of Scotland and in eastern England, and as much as 15° to 18° in the east of Scotland.

The day was marked by a little rain locally, the general weather being fair to cloudy or overcast, with little or no sunshine over a wide area, and where there was sunshine the temperature was not materially different from what it was in sunless localities. Banff had the best sunshine record, eight hours, with temperature 59°, Cambridge registering the same maximum with one and a half hours of sunshine, and Westminster without a ray of sunshine. There was some sea fog between Pembroke and the Channel Islands to account for the lower temperature records in that region.

This particular instance can be accepted as typical of what takes place on these occasions, but I must refer to one other case, because it is the most extraordinary within my long experience. There were many such during the abnormally stormy conditions which prevailed over the Atlantic in the winter of 1898–99 (see charts illustrating the weather of this period, Meteorological Office, Official No. 142). On February 10, 1899, when the greatest winter cold on record was being experienced in America, the temperature ranging down to −60° in Ontario and −61° in Montana, a south to south-west breeze brought to a great part of Europe unprecedented winter warmth. At Cahirciveen Observatory, on the Kerry coast, the thermometer mounted on that day to 54°. Thence eastward over a distance of at least 700 miles the following maxima were recorded:—56° at Scilly, 57° at Brest and Clifton, 61° at Jersey, 62° at Oxford, 66° in London, 69° at Paris, and 70½° at Liége and Verviers. Still further to the east, another 300 miles, and Berlin and Munich rose to 59°, the whole of central and southern Europe and as far east as the Caucasus experiencing a marked increase of temperature, but the warm wind did not affect Scotland and northern Europe. The Greenwich, Paris, and Brussels records (in the case of Paris extending back to the middle of the eighteenth century) disclose no other February maxima equal to those experienced on this occasion.

At high levels the crest of this remarkable heat-wave would seem to have lagged during the eastward advance, for at Davos Platz, at an altitude of more than 5000 ft., although the unprecedented February temperature of 53° was reached on the 10th, it was not until the 15th that the very extraordinary winter maximum of 63° was attained, and the same level was touched on the 19th. So exceptional was the warmth that the average maximum for the six days, 15th–20th, was as high as 61°, only one day being below 60°. Within a few days of each other Montana and Switzerland, in about the same latitude and at about the same elevation, had temperatures differing



by 124°, from −61° in a N.W. land-wind to +63° in a S.W. sea-wind.

How are we to account for the noticeable accession of heat which these observations show takes place as the air spreads across the land further and further away from what we regard as the seat of origin of the warmth? Thus far, the only suggestion I have received has been that perhaps it will prove to be of the Föhn character—a descending current. There are difficulties in the way of accepting this view. In the first place, our south-westerly winds are ascending rather than descending currents. We might be able to show that winds from the Atlantic crossing mountainous western Scotland are of the Föhn character on reaching the east coast, but it is scarcely likely that a Scotch Föhn would bring to Aberdeen a February temperature of 64° (more than 20° above the normal), as on the 22nd in 1897. Such eminences as exist in the south are too far distant to windward and of too moderate altitudes to produce any Föhn effect in London and the Eastern Counties, and across northern France, Belgium, and Prussia. The Davos Platz experience does not support the Föhn argument. It should be borne in mind that the phenomenon with which we are now dealing manifests itself at sea-level on the extreme western coasts before any high land is reached, and thenceforward there is a progressive accession of temperature, regardless of mountain and valley, sunshine and dullness, rainfall and dryness, thus placing the subject on a very different footing from that of the Föhn.

Now that the upper-air conditions are being so closely observed, daily and almost hourly, it should be possible at no distant date to accumulate sufficient evidence to make a special investigation of the circumstances, above and below, which combine to produce the temperature effects described above, and thus to enable us to arrive at the correct explanation of their causation and to predict their occurrence.

9 The Grove, Isleworth. HY. HARRIES.

The Perception of Sound.

BEFORE the discussion on the physiology of the internal ear is closed, it might be well to direct attention to a point in connection with the supposed necessity of the auditory nerve transmitting the very large number of impulses corresponding with the vibrations constituting musical tones.

Although the pitch of a particular tone is, say, 640 d.v. per second, it is not necessary that, in order to recognise it, we should listen to that tone for a whole second of time. Prof. McKendrick many years ago demonstrated that we could recognise as distinct from its predecessor and successor a note in a musical composition if it were listened to for only 1/64th of a second. In such a case this would mean that only ten condensations would affect the organ of Corti, and presumably only ten nerve-impulses ascend the auditory nerve. Prof. McKendrick, with whom it was my privilege to be associated at that time, studied the surface of the wax-cylinder records of musical compositions recorded for reproduction by the phonograph.

Since the speed of rotation of the cylinder was known, the number of impressions in the wax corresponding with each of a series of tones could be ascertained; and it was found that, in order to recognise any given tone, it was only necessary to "hear" that tone for not longer than 1/64th of a second. If I remember correctly, a shorter period still was in some cases demonstrated to be sufficient.

Now if, say, 1/100th of a second is long enough, it is clear that the hearing of quite high tones could be effected by a comparatively small number of vibrations or disturbances in the internal ear and of subsequent impulses in the nerve.

A tone of 2000 d.v. per second could be recognised by 20 impulses, and one of 10,000 pitch by 100, and so on. Apparently the auditory nerve is competent to transmit individual impulses of that order of frequency.

It seems to me that attention to this point will make the problem of hearing rather simpler than at first it appears by removing the necessity for believing that, in order to appreciate a note of a given pitch, we require to have the auditory nerve transmitting the large number of impulses corresponding with the large number of vibrations which, according to physicists, is the pitch or number *per second* of that note. In other words, the different tones in a musical composition follow one another with such rapidity that no particular note is produced for a whole second, and, therefore, not perceived for a whole second.

But, on the other hand, it is clear that we can listen to a high-pitched note for a second or for a minute or for any length of time. When we are hearing a note of 20,000 d.v. per second pitch, we are almost certainly *not* receiving 20,000 impulses per second into the central nervous system. To take an analogy from vision: when we perceive red light, we are certainly not receiving anything like (395×10^{12}) impulses per second, which is the "pitch" of red light. If, in seeing coloured light, such an enormous number of vibrations in the æther affect the retina, there must be something of a very different character as regards frequency, which, ascending the optic nerve, so stimulates the visual centre that we see coloured light.

We have in perceptual consciousness qualitative differences corresponding with objective quantitative differences, an ever-present problem of psycho-physics; and no one has ever suggested that our optic nerves and visual centres are dealing with impulses at many millions a second. Why, then, may we not apply the same reasoning to the ear?

When we are listening to all possible tones from, say, 1000 d.v. per second pitch to 40,000, may we not somehow have in consciousness qualitative differences corresponding with objective quantitative (arithmetical) differences? We cannot, apparently, be more definite than this.

In the case of the eye there is no conceivable possibility of an identity between the rhythm of optic-nerve impulses and that of the vibrations of the æther; is it not by analogy probable that neither is there any direct correspondence between the auditory nerve-impulses and the periodicity of sonorous vibrations?

D. FRASER HARRIS.

Dalhousie University, Halifax, N.S., November 29, 1918.

A Mistaken Butterfly.

THOUGH I cannot claim any special knowledge of insect behaviour, I hope you will allow me to make a few remarks on "A Mistaken Butterfly" discussed in NATURE for September 5 and December 12, 1918. I have my doubts as to whether it was the butterflies or the observers who were mistaken. A butterfly does not always alight on a flower, or on what it supposes to be one, but appears frequently to alight for rest. Now, in selecting a resting-place, it will naturally select a good "taking-off" position, and the knob of a hatpin and a golf ball are evidently from the butterfly's point of view good "taking-off" positions, especially the golf ball, it being surrounded by no good "taking-off" places, and its whiteness would help to direct attention to it.

A number of years ago I met two keen entomologists in Italy who were disappointed in not succeeding in capturing a butterfly they particularly wanted, though they had seen a number, but failed to net them. As I knew where that particular butterfly was likely to be found, I took my walk in that direction the following day, and on returning presented my friends with two specimens of the butterfly. These were captured without a net, by what I imagine is a well-known method. When the butterfly alighted I approached it from behind, keeping as well out of the range of its eyes as possible, and moving *very slowly*. When within arm's reach the hand was slowly stretched out, keeping it as low as possible and behind the insect. When the stalking is carefully done a capture is generally made, and the wings, before lifting it, may be folded to prevent their upper surfaces being damaged by contact with the fingers.

Now in the case of the two butterflies referred to, one was picked off a leaf of a bush, and the other had settled on my shoulder. I do not think they are so easily picked up if they have settled on flowers, as they are there on business, and are restless and away whenever they have accomplished their object.

JOHN AITKEN.

Ardenlea, Falkirk, December 17.

THE FUTURE OF BRITISH MINERAL RESOURCES.

NOW that the activities of a number of Government Departments, which were called into existence by the exigencies of the war, are happily likely to be nearing their end, we may hope to see the reports of their work given to the public; it is to be desired that a mass of valuable information, accumulated often at vast expense, should not be relegated to the limbo of a cobwebbed official pigeon-hole, but should be made generally available. It is scarcely to be expected that many of these reports will be as valuable as that lately issued by the Controller of the Department for the Development of Mineral Resources in the United Kingdom (Cd. 9184, price 6*d*. net), seeing that Sir Lionel Phillips was one of the rare exceptions amongst the small army of Controllers appointed by the Government, inasmuch as he had a thorough acquaintance with his subject before he assumed control; perhaps also that is why he did not hold his office for very long. It is characteristic of the attitude of the Ministry of Munitions towards a courageous and capable official under it, that the Minister takes special care to state that he accepts no responsibility for the opinions and conclusions contained in this report.

The report consists first of a summary of the conclusions arrived at by the Controller, and then of a part divided into two sections, dealing with statistics of production and the inferences to be drawn therefrom. For the numerous valuable tables contained in this report the original must necessarily be consulted, but some of the conclusions of Sir Lionel Phillips deserve both study and comment. He shows clearly that the native British production of non-ferrous metals falls far short of our requirements in normal times, as follows:—

	Production. Tons	Consumption. Tons
Lead	17,000 ...	179,000
Tin...	5,139 ...	21,000
Zinc	4,797 ...	185,000
Copper	139 ...	130,000

The tendency of the report is to show that no very great improvement in output is to be expected, except perhaps in a few isolated instances; it is shown that the output of non-ferrous metals has been falling off continuously for the last sixty years. The main causes assigned for this fact are the impoverishment or exhaustion of the deposits, and the increased costs of ore extraction and of pumping on one hand, and fall in value of metal on the other. Sir Lionel Phillips also lays stress upon the mismanagement of many mines, the unbusinesslike methods employed, and the lack of co-operation and combination amongst mine-owners. He further directs attention to another drawback, of which all engaged in the management of metal mines in this country are only too well aware, in the following words:—"Labour in the non-ferrous mines has in the past been paid on rather a low level; the wages have been, moreover, in many cases the reward for part-time service, many employees having small farms of their own or being habituated to dual occupations. The system is utterly pernicious, and involves great waste of the men's time and energy in going to and from the scenes of respective work, and entails poor efficiency all round. It has endured from time immemorial, and any change that may be brought about now can only be very gradually effected."

This criticism upon the labour conditions is perfectly sound, and will be endorsed by everyone who knows the system of working, especially in our lead and zinc mines. It is evident that with impoverished deposits, poor management, and inefficient labour the outlook for the non-ferrous metal-mining industry is not a very bright one. There are, however, a number of other difficulties to be contended with; perhaps the most serious is the question of taxation. It is clearly pointed out that "mines are, at best, wasting assets," and that "in all mines earning profits the amounts distributed to proprietors as dividends or profits consist not only of income, but include the return of capital as well. . . . To tax mining profits on this basis is to tax capital as well as income, and to differentiate unfairly against persons who invest in mines." Furthermore, the present system of taxation discourages the formation of a reserve fund to meet the inevitable fluctuations of mining, and as the report says: "Reserve funds so derived should not be taxed. Similarly, the tax-gatherer should not levy toll upon sums spent out of profits in development." Sir Lionel Phillips does not go on to draw the inevitable inference that the unhappy state of the metal-mining industry has to a large extent been brought about by this injudicious system of taxation; it is, however, clear enough that the discouragement of development must tend to leave mines impoverished or exhausted, since it prevents the discovery of new deposits or shoots of ore. It is hopeless to expect a sound policy of management when the accumulation of a reserve fund, which should form the basis of such a policy, is mulcted in taxes. Sir Lionel Phillips does not think that compulsion could be applied to force mining companies to set aside each year out of profits sums estimated as sufficient to redeem their capital; in France, however, the building up of a "legal reserve" is obligatory, and the system appears to work quite satisfactorily.

There is very much in this report that will repay careful perusal, and stress may well be laid upon the recommendations which urge the formation of a Mines Department for the United Kingdom, this Department having for its object the study and encouragement of the home mineral industry. The report is careful to point out that nothing more than advice and assistance is required from a Government Department; as the Controller says: "That there has been too little interference by Government in the past will be generally admitted. That there can well be too much interference is equally obvious. . . . Government cannot, I believe, undertake any industrial work as efficiently as individuals whose material well-being depends upon the result. The nationalisation of mines would, therefore, be disadvantageous to the country. . . . In most industrial enterprises, and certainly in mines, there is an element of hazard which fortune-seekers are willing and are bound to take, but which the Government ought not to, and permanent officials never would, take." There is no doubt that these opinions would receive the unanimous endorsement of all mining engineers experienced in the direction of British mining enterprises, and it is to be hoped that the Government of the country will give heed to the findings of the Controller of this important Department of national industry.

H. LOUIS.

SUPERSATURATION AND TURBINE THEORY.[1]

IT has become of late years increasingly obvious that the equilibrium state of saturation, assumed as the basis of the theory of the steam-engine, does not apply accurately to the case of rapid expansion, especially in turbines. Steam in rapid expansion does not even begin to condense until its temperature has fallen far below the saturation limit. This fact has been familiar for many years as a general property of vapours called supersaturation, but it was not realised until recently that it might produce effects which could not be ignored in practice. Many authorities (*e.g.* Prof. Rateau, "Flow of Steam," 1905) held that there was no appreciable retard in the condensation even in a steam-nozzle where the expansion reaches the limit of rapidity. On the other hand, Callendar and Nicolson (Proc. Inst. C.E., 1897) found experimental evidence of supersaturation in the cylinder of a reciprocating engine at comparatively low speeds. Assuming that the adiabatic of supersaturated steam was simply a continuation of that of superheated steam, they calculated that a loss of 20 per cent. of available heat-drop would result at low pressures if there were no condensation; but as there was known to be a limit to the state of supersaturation they estimated that the actual loss due to this cause would not exceed 5 per cent. to 10 per cent. in practice, depending on the range and rapidity of expansion.

The first definite measurement of the supersaturation limit was obtained by Mr. C. T. R. Wilson (Phil. Trans. R.S., 1897) by expanding water vapour mixed with air at 20° C. It was found that the mixture could be expanded in the absence of dust or other nuclei without any con-

[1] "A New Theory of the Steam Turbine." By Harold Medway Martin. Reprinted from *Engineering*, vol. cvi. Pp. 22+folding diagram.

densation occurring until the density of the vapour was about eight times that of saturation at the lower temperature, but that beyond this point the condensation was so dense as to suggest that a natural limit of supersaturation had been reached. Experiments on steam-jets by Barus and others suggested a similar limit for steam at high temperatures free from air, though the precise ratio of density required could not be directly obtained from such experiments. Taking the density ratio given by Wilson as the limit of supersaturation, the discharge through a nozzle was calculated by Callendar (Proc. Inst. Mech. Eng., January, 1915), and shown to afford a reasonable explanation of well-known anomalies.

Admitting the supersaturation limit thus defined, the discharge through a nozzle comes out about 5 per cent. greater than that given by the older view, and agrees much better with the results of experiment. The available heat-drop to the supersaturation limit is about 5 per cent. less, involving a corresponding loss of work. So far the result is definite, depending only on the limit assumed and the equation of the adiabatic, which is fairly certain. Beyond this point the loss must depend on the rate of expansion, but it is still possible to calculate an upper and a lower limit. The maximum heat-drop is obtained by assuming that, when once condensation has started, the temperature follows the ordinary saturation limit in isentropic expansion, in which case there is no further loss of available heat-drop. On the other hand, assuming that the temperature cannot fall appreciably below the supersaturation limit, however rapid the expansion, the maximum *loss* is obtained by assuming that the temperature follows the supersaturation limit, in which case the loss continually increases with increase of entropy, but reaches a nearly constant percentage, about 8 per cent., of the total heat-drop at low pressures.

In the work before us the author adopts a slightly different definition of the supersaturation limit. Instead of taking a simple ratio of densities as proposed by Wilson, he assumes that the effective radius of the supersaturation nucleus remains constant at different temperatures. In the absence of experimental evidence at high temperatures, it is scarcely possible to decide between the two assumptions, except that the first is the simpler in application. The two corresponding curves for the supersaturation limit agree so closely at pressures between 1 lb. and 15 lb. that they give practically identical results when applied to any turbine problem. Now that one of the leading exponents of turbine theory has set the example we may confidently expect that other useful applications of the supersaturation hypothesis will follow, and that more accurate determinations of the limit will be made in the near future.

The "New Theory" gives an example of one such application of great practical interest—namely, the effect of superheat in improving the efficiency, which confirms the hypothesis of supersaturation, and throws light on the probable state of the steam in an actual turbine by comparing theory with experiment.

According to the older theory of isentropic expansion of saturated steam, the effect of a moderate degree of superheat in improving the relative efficiency of a turbine should be practically negligible, whereas even the earliest experiments in this direction showed that the improvement was strongly marked. The improvement was generally attributed to elimination of friction due to the presence of water (Stodola, "Steam Turbines," p. 137), but Osborne Reynolds showed this explanation to be unsatisfactory. The supersaturation theory of expansion requires that the improvement should be most marked in the early stages of superheat, owing to the reduction of supersaturation losses, which diminish most rapidly with the first rise of temperature. The most trustworthy and recent experimental results on the improvement due to superheat are probably those given by the correction curves of Baumann (Journ. Inst. Elect. Eng., 1911), which are generally regarded as accurately representing the case of the modern high-speed turbine.

Mr. Martin shows that these results can be satisfactorily explained on the supersaturation hypothesis provided that we are prepared to admit that the temperature of the steam, after condensation has set in, remains much nearer the supersaturation than the saturation limit, dividing the interval in the ratio 1 to 4. His method, involving the estimation of reheat factors, may appear indirect, but tends, if anything, to exaggerate the effect of superheat in reducing the supersaturation losses. The present writer has made many similar calculations, which corroborate Mr. Martin's, and tend to show that the temperature of the steam must be very near the supersaturation limit in the later stages of expansion in a high-speed turbine. A result so strongly at variance with the generally accepted theory cannot fail to act as a stimulus to further research on the effects of supersaturation, and may lead to appreciable improvements in design when proper account is taken of these essential physical properties of steam.

H. L. CALLENDAR.

THE EPIDEMIOLOGY OF PHTHISIS.[1]

TUBERCULOSIS, and particularly pulmonary tuberculosis (phthisis, or consumption of the lungs), still remains one of the health problems of the age. The Medical Research Committee has, therefore, been well advised to institute an inquiry into the epidemiology of phthisis in Great Britain and Ireland, of which this report by Dr. John Brownlee is the outcome.

The present investigation is a statistical analysis of the Registrar-General's returns of mortality, mainly for the five decades 1851–60 to 1891–1900, for the constituent countries as a whole and also for certain districts of them. By this means remarkable differences are brought out respecting the age at which the maximum death-rate from phthisis occurs in different localities. If we take the deaths of males from phthisis in England and

[1] An Investigation into the Epidemiology of Phthisis in Great Britain and Ireland. Medical Research Committee, Special Report Series, No. 18.

Wales for 1901–10, the death-rate rises from 250 per million at fifteen years of age to a maximum of 2750 per million at forty-seven years of age, after which it steadily declines to 500 per million at eighty years of age, the curve being almost symmetrical. For London the curve is much the same, though steeper, because the maximum death-rate is higher, being 4500 per million at fifty years of age. Lancashire and Staffordshire show a very similar curve. If, however, we take the figures for North Wales for males for the same period (1901–10), the death-rate rises abruptly from 500 per million at fifteen years of age to 2800 per million at twenty-three years of age, continues at about this level up to fifty years of age, then rises slightly up to sixty years of age, and then declines (the curve for Norfolk is much the same). The curves for London and for North Wales are thus utterly different. Cornwall shows a well-marked secondary rise, and the form of the curve is the same whether the tin-miners, who are specially prone to phthisis, be included or not. For this county the phthisis death-rate rises to about 2600 per million at thirty years of age, declines to 1300 per million at forty years of age, rises again to 3250 at sixty years of age, and then falls.

Similar differences are met with in Scotland. The phthisis death-rate among males in Shetland for the years 1881–1900 rises steeply to 6000 per million at twenty-three years of age; it then falls almost regularly to 1500 per million at fifty years of age, and continues at about this level until seventy is reached. For Midlothian, including Edinburgh, on the other hand, the curve is very similar to the London one, with a maximum death-rate of 3750 per million at 42½ years of age. For Ireland the curve is not unlike the Shetland one, a maximum death-rate of 4500 per million being attained at twenty-seven years of age, with the exception that it declines almost regularly to 500 per million at seventy-five.

From these and other data the conclusion is arrived at that phthisis or consumption of the lungs is not a single disease, but rather a group of diseases, of which one type attacks the young adult, the commonest age of death lying between twenty and twenty-five; a second type has its incidence at middle life, killing most commonly between forty-five and fifty, while a third type may exist, but less certainly distinguished, with its chief mortality between fifty-five and sixty-five. In diseases such as cerebro-spinal fever and pneumonia four or five different races or varieties of the respective specific micro-organisms are now known to exist, and the results of this statistical inquiry suggest that something of the same nature may obtain as regards the tubercle bacillus of pulmonary tuberculosis or phthisis. In the introduction to the report it is stated that the bacteriologist has not yet discovered "type" differences among the human tubercle bacilli of phthisis. This statement is not altogether correct, for certain observers have arrived at the conclusion that there are at least two types of the human tubercle bacillus of phthisis with distinctly different properties, which may be differentiated by certain methods. Other matter of considerable interest is also included in the report, viz. an examination of the phthisis death-rate in London since 1631, the relationship of phthisis to certain occupations (among tin-miners the death-rate is 16,500 per million at fifty to fifty-five, while among coal-miners it never rises above 2000), and the relationship of phthisis to environment. The report is illustrated with twenty-six diagrams showing the phthisis and other death-rates in graphic form, which give a far better idea than words could do of the variations alluded to above.

R. T. HEWLETT.

NOTES.

THOSE engineers who have been advocating the electric drive of ship propellers will read with mixed feelings the announcement made on January 2 by Mr. Daniels, the Secretary of the U.S. Navy, that in the future all the capital ships of that Navy will be electrically driven. There is no reason to doubt that the new American Dreadnought—the *New Mexico*—is a great success. Steam turbines are used, and in order to get their highest efficiency they must be kept running at high speeds. The ship's propellers run at much lower speeds, and so direct driving is out of the question. The turbines are directly coupled to dynamos, and the electric power generated is transmitted to motors directly coupled to the propellers. The relative speed of the turbines and the shafts can be adjusted to any desired value with the greatest ease by merely turning the controller-handle. The experiments undertaken in this country a few years ago were carried out in a timid and hesitating way both from the engineering and the financial point of view, and the results were generally disappointing to the electrician designers. It is possible, but by no means probable, that slow-speed turbines may be developed in the future. In the meantime, we hope that British shipbuilders will make larger use of the electric drive in the future than they have in the past.

THE *Times* for January 3 announces that the world's altitude record has been broken by a British biplane, which flew from Martlesham Heath and attained a height of 30,500 ft.—1500 ft. higher than the summit of Mount Everest. The machine was piloted by Capt. Andrew Lang, R.A.F., with Lieut. Blowes as observer, Capt. Lang having previously made two attempts to beat the American record. It is of considerable interest to note that the height attained was limited by the failure of petrol-pump pressure, due to the rarity of the air, and not by the aerodynamic performance of the machine. The machine was fitted with a Napier Lion engine, but it is not stated whether forced induction was employed to keep up the engine power at this enormous altitude, where the air density is only 28 per cent. of its ground value and the temperature of the order −40° C. It would appear, however, that even greater heights could be reached if minor difficulties, such as those connected with carburation at low temperatures and the maintenance of the pilot's comfort, were overcome. Meanwhile, it is gratifying that the record should be held by British aviators, and we hope that it may continue to be so held in the future.

PRESIDENT WILSON has been given a most cordial reception in Rome during the past few days. He has been admitted a member of the ancient Accademia dei

Lincei, and on January 4 received representatives of the chief universities of Italy. We learn from the account of the visit given by the *Times* correspondent at Rome that the first to be presented were representatives of the University of Rome, headed by the rector, Prof. Tonelli. Signor Salandra, as president of the faculty of law, read an address in Latin recounting the achievements of the President, and conferring on him the degree of doctor in jurisprudence (*honoris causa*). The diploma was then presented by Prof. Tonelli. There followed representatives of the University of Padua, headed by Prof. Lori, who conferred on the President the degree of doctor of laws. Next came the turn of the University of Bologna. Mr. Wilson had already received a degree from the university, but Prof. Galanti gave a special greeting in the name of the university. Last came the Marquis Torrigiani, who, in the name of the University of Florence, conferred on the President the degree of doctor in letters.

THE Director of the British Museum (Natural History) has received the following letter from the National Museum of Natural Sciences, Madrid:—"Please let us congratulate very warmly your museum on the end of the great war, so glorious an end for your country and for the cause of universal freedom and peace.—Believe us, sir, yours very friendly, Ignacio Bolivar (director), Eduardo H. Pacheco, Joaquin Gonzalez Hidalgo, Luis Lozano, Lucas F. Navarro, Angel Cabrera, Antonio de Zulueta, Ricardo Mercel, Cándido Bolivar, and Romualdo Gonzales Fragoso." The director of the Museo Nacional wishes the letter to be taken, not as a mere formula of courtesy, but as an expression of sincere feelings of sympathy on the part of the signatories towards this country. We feel sure that our readers will cordially appreciate and reciprocate this friendly message from Spain.

THE Faraday Society has arranged a general discussion on "The Present Position of the Theory of Ionisation," to be held on Tuesday, January 21, from 5 to 6.30 and from 8 to 10 p.m. in the rooms of the Chemical Society, Burlington House, W.1. Sir J. J. Thomson will preside over the discussion, which will be opened by Prof. G. Senter. Among contributors of papers will be Prof. S. Arrhenius (Stockholm) Prof. S. F. Acree (Syracuse, U.S.A.), Capt. J. W. McBain, Mr. W. R. Bousfield, Dr. E. Newbery, Dr. N. R. Dhar (Paris), Dr. Henry J. S. Sand, Prof. A. W. Porter, Dr. E. B. R. Prideaux, and Capt. J. R. Partington.

WE notice with much regret the announcement of the death on January 6, at sixty years of age, of Col. Theodore Roosevelt, ex-President of the United States of America, and distinguished in the scientific world by his observations on big game and his work for the establishment of bird reservations and other means of conserving places and objects of natural beauty and interest.

THE death is announced, in his eighty-ninth year, of Dr. Thomas Buzzard, consulting physician to the National Hospital for the Paralysed and Epileptic, Queen Square, London; ex-president of the Clinical, Neurological, and Harveian Societies; a foreign corresponding member of the Société de Neurolgie of Paris; and the author of many works on diseases of the nervous system.

NEWS has just reached us of the death on October 1 last, in his sixty-first year, of the distinguished mathematician-philosopher, Gaston Milhaud, professor at the Sorbonne, Paris. Prof. Milhaud occupied an almost unique position, indicated in the special subject for which his chair was created by the Sorbonne in 1909, "History of Philosophy in its Relations with the Sciences." His strong historical sense made him especially sympathetic as a philosopher, and enabled him almost instinctively to place himself at another philosopher's point of view—a rare intellectual gift. His first published work, "Leçons sur les origines de la science grecque," appeared in 1893, and marked the special direction of his studies. It was followed in the next year by "L'Essai sur les conditions et les limites de la certitude logique." This was his thesis for the Doctorat ès lettres, and aroused great interest, passing through several editions. Prof. Milhaud is better known in this country by his books "Les philosophes géomètres de la Grèce" and "Etudes sur la pensée scientifique chez les Grecs et les Modernes." During his last years he had been engaged on a special study of Descartes. Portions of this have appeared from time to time in reviews, and the whole, we hope, will now be published.

COUNT HERTLING, German ex-Imperial Chancellor, was one of the great political leaders who combined philosophy as a profession with statesmanship. His first professorship was at Bonn, and in 1880 he became ausserordentliche professor of philosophy in the University of Munich. His principal books are "Materie und Form und die Definition der Seele bei Aristoteles" (1871), "Ueber die Grenze der mechanische Naturerklarung" (1875), "Albertus Magnus" (1880), and "John Locke und die Schule von Cambridge" (1892). He was also the author of numerous articles on political philosophy.

OWING to the exciting events which were happening last year, the death of Marcel Deprez, one of the greatest of electricians, on October 18 last, has almost passed unnoticed in this country. In his early life Deprez made many valuable researches by means of various novel devices on the pressures developed in cannons during explosion. It was not until 1881, however, when he was thirty-eight years old, that he devoted himself to the application of electricity to industrial purposes. In that year, in conjunction with Carpentier, he patented the method of transmitting power by high-tension electricity, using step-up and step-down transformers. His profound faith in theory enabled him to surmount the many difficulties with which the early pioneers of power transmission were faced. Deprez was the first to prove that the method was commercially feasible. His study of the curves devised by John Hopkinson to explain the working of a dynamo led him to the invention of the compound winding by means of which the voltage of a dynamo can be maintained constant at all loads. In conjunction with d'Arsonval and Carpentier he invented a series of measuring instruments which are in common use in every country in the world. In 1890 Deprez was elected professor of industrial electricity at the Conservatoire des Arts et Métiers. A long illness and the war prevented him from completing several important scientific and industrial researches on which he was engaged. We unite with our French *confrères* in paying homage to the memory of one whose inventions have played such a notable part in the industrial development of the world.

THE death at Tacoma, Washington, U.S.A., on November 14, 1918, is announced of Prof. George Francis Atkinson, head of the department of botany at Cornell University since 1896. Born in 1854, and educated at Cornell, where he graduated in 1885, Prof. Atkinson was appointed associate professor of cryptogamic botany at his own university in 1893. In 1894 he issued, under the title of "The Study of the Biology of Ferns by the Collodion Method," a useful, practical study of fern-structure, especially of the sporangia, spores, prothallia, and embryo. But his work was mainly on the fungi, and he published numerous papers on the life-history, physiology, and taxonomy of members of this group. Much of his work dealt with fungi as the cause of disease, especially in cotton and other cultivated plants. As a guest of the British Association and an active member of the meetings of the International Botanical Congress at Vienna in 1905 and at Brussels in 1910, Prof. Atkinson was known personally to many British botanists. He took a keen interest in the meetings of the Section of Nomenclature at Vienna and Brussels, particularly as regards the various groups of cryptogams.

ON January 1 last, by arrangement with the Director of the Meteorological Office, the *Morning Post* commenced the regular publication of the weather map of the previous evening (6 p.m.). The map, two columns wide, is on the same scale as those for 1 a.m., 7 a.m., and 1 p.m. which are given in the official Daily Weather Report. There would seem to be considerable delay in the telegraph service of observations from France, for while reports from the Low Countries, Scandinavia, and Iceland arrive in time for inclusion in the map, those from France are conspicuous by their absence so far. Their prompt arrival would add greatly to the value of the map. Wireless reports from ships out at sea are to be added as soon as the new service is organised.

THE year 1918 ended with a remarkably mild December, the mean temperature at Greenwich for the month being 45·8°, which is 5·8° in excess of the normal. The whole month was mild except two days at Christmas and on December 20 and 21. The mean temperature was 2·6° higher than November, and it was warmer than any of the months from January to April inclusive. December was also very damp, although the rainfall was 0·25 in. less than the normal. At Greenwich the mean temperature for 1918 was 50·5°, which is 0·5° above the average. The warmest month was August, with a mean 62·9°, and in July the mean was 62·6° January was the coldest month, with the mean 39·7°. The change of temperature from month to month was greatest from April to May, the mean increasing from 45·2° to 56·4°, a difference of 11·2°. Rain fell on 190 days at Greenwich during the year; the aggregate measurement was 28·5 in., which is 5 in. more than the normal. July was the wettest month with 7·34 in., which is 5·16 in. more than the normal; the month was the wettest July on record, whilst October, 1880, is the only month at any period of the year with a heavier rainfall during the last hundred years. September was also very wet, the rainfall measuring 2·72 in. more than the normal, and at Greenwich it was the wettest September since 1896; of recent years September has been generally dry. March was the driest month with 0·97 in., and February was almost equally dry. Snow fell in London on seventeen days, all from January to April; there was no snow during the later months of the year. Bright sunshine was registered for 1510 hours, which is forty-two hours more than the normal. June was the brightest month with 224 hours' duration of sunshine, and December the dullest with only twenty-six bright hours.

PROF. DE QUERVAIN, the well-known Swiss seismologist, has made a suggestion which deserves the very careful attention of our military authorities and of scientific men in this country. There are at present large stocks of high explosives in every country which cannot be preserved and must be denitrated or exploded. He suggests that fifty tons should be exploded at definite times and under various atmospheric conditions, and that observers in all the surrounding area should be requested to listen for the sound. Prof. de Quervain is discussing the necessary arrangements for making such experimental explosions in Switzerland with the military authorities of that country; and it would be difficult to support too strongly his wish that concurrent experiments should be made in Great Britain. If made in the neighbourhood of seismological stations—for example, near Eskdalemuir—the experiments might be of military value. They could not fail to throw far more light than accidental unprepared explosions on the many problems presented by the transmission of sound-waves by the atmosphere. We may add that the Swiss War Office has already presented ten thousand kilograms of lead and steel from its surplus stores for the bob of the new three-component seismograph.

WE have received from the Scripps Institution for Biological Research, University of California, a copy of a lecture by Dr. Francis B. Sumner on the value to mankind of experiments on animals. Public opinion over here tends to dismiss the subject as *chose jugée*: and one of the many lessons of the war has been in the proof that thousands and thousands of our men have been safeguarded against typhoid and tetanus by methods gained from experiments on animals. Perhaps in the United States there is more need of this sort of scientific propaganda: and this lecture is a very good historical review of the whole subject. We will not here go over the ground which we have won. But Dr. Sumner makes a point which some of us are apt to forget. He directs attention to the fact that some of the more violent opponents of all experiments on animals are not only lovers of animals, but haters of science and of orthodox medicine. He quotes, for instance, an invitation from the lady who is president of the New York Anti-Vivisection Society to "all anti-vaccinationists, anti-vivisectionists, eclectics, homœopaths, chiropaths, osteopaths, naturopaths of all branches, Christian Scientists, New-Thoughtists, Theosophists, Medical Freedomists, and all brave and honest physicians of the allopathic school (who secretly denounce the machinations and conduct of the political doctors) to enrol as active participants in an Association of Free People against Medical Tyranny." And there are one or two people among us over here who talk more or less like this. It may be perfectly true that the medical man is no better than he ought to be. But, as Dickens says, what a blessing it would be if we were all of us only as good as we ought to be!

THE Kew Bulletin (No. 10, 1918) contains a remarkable letter sent to Kew by the late Mr. C. O. Farquharson, mycologist in Nigeria, who was drowned as the result of the loss at sea through collision of the s.s. *Burutu*, on which ill-fated ship he was coming home on leave (see NATURE, November 7, 1918). The letter is an epitome of Mr. Farquharson's life-work in Nigeria, and gives a very graphic account of the nature of the work of a tropical mycologist, the methods by which he sought to solve the many difficult problems with which he was confronted, and the kind of education that his experience had led him to believe best for such work. In the course of the letter some interesting observations on the cultivation of ground-nuts and on cacao diseases are recorded. The main theme of the letter is that most tropical diseases of cultivated plants are amenable to good cultivation and proper sanitation, and that spraying and the introduction of entomogenous fungi to kill insect pests are rather an expression of ignorance than a real means of combating the troubles due to insect and fungus pests. The letter is deserving of careful attention by all tropical mycologists and by those interested in problems of tropical agriculture, as well as by those who are concerned with the training of mycologists for work in our Colonies.

THE botanical collections made on Mount Korinchi, Sumatra, by Messrs. C. H. Robinson and L. Boden Kloss have recently been worked out by Mr. H. N. Ridley and published in vol. viii., part iv., of the Journal of the Federated States Museums. Mr. Ridley has described the flowering plants and ferns, and the accounts of the mosses and Thallophytes are the work of Mr. H. N. Dixon and Miss Lorrain Smith respectively. These collections throw much light on the highland flora of Sumatra, and it is remarkable that the flora of so large and accessible an island should heretofore have received so little attention. One new genus, Hovella, and no fewer than one hundred and forty-two new species of plants are described, a large number being orchids. It is of interest to find that there is a considerable Himalayan element present in the Sumatran highlands, and some of the genera are also found in Borneo and Malaya. In Malaya, however, they occur only in the Telom mountain district. The Sumatran and Javan mountain floras appear very similar. Two interesting plants, *Goodyera schlechtendaliana* and *Potamogeton oxyphyllus*, var. *fauriei*, have, previous to this, only been recorded from China and Japan. The distribution of the Gesneraceæ is also very interesting, and affords ground for a comparison of the floras of India, Malaya, and Java with that of Sumatra. A very remarkable new Carex, *C. hypolytroides*, was found at 7300 ft. on Korinchi Peak, with stems 6 ft. in height, the whole plant being quite distinct in appearance from any other known Carex.

A VALUABLE contribution to West Australian botany, made by Dr. C. H. Ostenfeld, of Copenhagen, has appeared in *Dansk Botanisk Arkiv* (No. 6, 1916, and No. 8, 1918). Dr. Ostenfeld's studies are based on his visit to Australia with the British Assosiation in 1914. In the first part the "sea-grasses" belonging to the families Potamogetonaceæ and Hydrocharitaceæ are described, with an excellent series of figures in the text, and a new species, *Cymodocea angustata*, is described. A full biological account, including a description of the peculiar vivipary of *Cymodocea antarctica*, is given under each species. In part ii. particular attention is given to the genera Triglochin, Crassula, and Frankenia, with good plates and text-figures, several new species being described. The opening paper consists of a general account of the vegetation with a map, and the mangrove formation, the sandy seashore formation, the salt-pan formation, the sand-dune formation, and the savannah forest formation are discussed in detail. An interesting and characteristic tree of the savannah forest is *Adansonia gregorii*, the only species of this genus known outside Africa. All the other species are confined to tropical Africa, and the original home of the genus appears to have been Madagascar. The Chenopodiaceæ collected by Dr. Ostenfeld are described in part ii. by Dr. O. Paulsen, and four new species are described and figured.

A BRIEF, but extremely interesting, account of the spawning of the little smelt (*Leuresthes tenuis*) appears in *California Fish and Game* (vol. iv., No. 4). This fish appears in immense shoals on all sandy beaches near San Diego during March, April, and May on the second, third, and fourth nights after full moon at full tide. Huge schools then make for the mouth of small fresh-water streams for the purpose of spawning in the sand. The fish apparently strive to get as far shoreward as the waves will carry them. As the water recedes each wriggles down into the sand, at the same time releasing eggs and sperm. The reproductive products discharged, the return to the sea is made by springing back into the next high wave that reaches them. The fertilisation of the eggs thus laid in the sand is effected during the churning-up of the sand by the waves as they rush up the beach. Since these events take place at night, usually from ten to one o'clock, those who have made these observations are to be congratulated, for they have accomplished much under very trying conditions.

THE *American Museum Journal*, vol. xviii., No. 6, contains a brief description of a remarkably perfect skeleton of an Oligocene alligator, from the Big Bad Lands of South Dakota. Though found some years ago, the fossil has only recently been extracted from its matrix. This is a find of some importance, and an excellent photograph of the specimen accompanies this description. It was apparently an immature example, and is minus the tail. But the dermal armature is most wonderfully preserved.

THE thirty-second annual report of the Marine Biological Station at Port Erin shows that in 1918 there were sixteen workers, including eleven senior students in the usual Easter Vacation class. Miss Mayne records some preliminary observations on common littoral organisms with the object of ascertaining the possible density of the population. Choosing the most thickly covered parts of the shore, she found on one square foot of rock 2940 barnacles (*Balanus balanoides*), on another square foot thirty-seven limpets, and in a small pool there were within a square foot twenty-five anemones—twenty Actinia and five Sagartia. Appended to the report is an address by Prof. Herdman on some periodic changes in Nature, with special reference to the changes in the alkalinity of the water of the Irish Sea and the correlated changes in the nature of the plankton.

A REPORT by Prof. Sheridan Delépine on the method recommended by the Sub-Committee of the Anthrax Committee for the Disinfection of Anthrax-infected Wool (see NATURE, June 13, 1918, p. 290, and July 4, p. 347) has been issued (vol. i. of the Report to the Home Office of the Departmental Committee on Anthrax). Prof. Delépine approves generally of the method of disinfection proposed. He directs attention to the importance of temperature in the process—a certain strength of formol which may not destroy the anthrax spores at a lower temperature becomes effective at a higher temperature. The process requires large quantities of warm water for washing the wool, and this wash-water must not be discharged until thoroughly disinfected. The process is applicable only after the bales of wool have been opened, and offers no protection to the workmen engaged in this preliminary work. To be effective also, the process must be carried out thoroughly, the strength of disinfectant and the temperature at various stages being under constant and accurate scientific supervision, and the results frequently controlled by searching tests.

THE Orders which placed glycerine, benzine, methylated spirit, and turpentine on the prohibited list have probably caused much inconvenience to microscopists. In the Journal of the Royal Microscopical Society for September Mr. John Ritchie, jun., describes some experiments on the use of acetone as a solvent for resinous media. Several methods of preparing balsam in acetone are described. The use of acetone enables the object to be transferred directly from alcohol without the intervention of oil of cloves, but balsam so dissolved appears to have a lower refractive index than in cases in which xylol or benzole is the solvent. In this connection it may be mentioned that a recently introduced "turpentine substitute" answers well for thinning balsam that is in a slightly viscid state.

THE Saxon State Railways are now submitting their engine-drivers and other responsible train officials to certain tests in their psychometric laboratory at Dresden. According to the *Zeitung des Vereines deutscher Eisenbahnverwaltungen* (October 2), the tests comprise strength of will and endurance, and fatigue where there is physical strain. The Dubois ergograph is used for the purpose, the object being to trace a fatigue curve. The forearm rests on the table; over the middle finger is run a catgut loop, which passes over a pulley, the other end of the gut supporting a weight of from 4 to 8 kg., according to the suitability of the subject. When the middle finger is bent the weight is raised, and when relaxed again the weight is dropped, the process of this motion being traced on a recording drum. With every stroke the drum advances 1 mm., and every two seconds a clockwork movement records a time mark, so that fatigue in terms of time can be read from the final curve. In addition to giving the mean efficiency in metre-ergs per second, the ergogram also shows the degree of fatigue (*i.e.* diminished efficiency) per minute, as well as the number of lifts which the subject has to make in order to do 1 metre-kilogram of work. The system has been said to give satisfactory results as regards the selection of men for the proper posts.

AMONG announcements of forthcoming books of science we notice the following:—"A Source Book of Biological Nature Study," E. R. Dowling, and "The Geographic and Economic Foundations of the Great War," J. P. Goode (*Cambridge University Press*); "Studies in Neurology," Dr. H. Head, 2 vols., illustrated; "Menders of the Maimed," Prof. A. Keith, illustrated; "A Physical Interpretation of Shock, Exhaustion, and Restoration," Lt.-Col. J. W. Crile; "Manual of War Surgery at the Base," Lt.-Col. S. Barling and Capt. J. T. Morrison, illustrated; "Trench Fever," Major W. Byam; "The Nervous Heart," Dr. A. McNair Wilson, illustrated; and "Surgical Aspects of Typhoid and Paratyphoid Fevers," Col. A. E. Webb-Johnson, illustrated (*H. Frowde and Hodder and Stoughton*); "Catalysis in Industrial Chemistry," Prof. G. G. Henderson; "The Human Machine and Industrial Efficiency," Prof. F. S. Lee; "Experimental Education," Dr. R. R. Rusk; "Education and Social Movements, 1700–1850," A. E. Dobbs; and a new edition, in three volumes, of "A System of Physical Chemistry," Prof. W. C. McC. Lewis (*Longmans and Co.*); "The Problem of Nervous Breakdown," Dr. E. L. Ash (*Mills and Boon, Ltd.*); "Rudiments of Handicraft," W. A. S. Benson (*John Murray*); "Mental Disorders of War," Prof. J. Lepine, edited by Dr. C. Mercier; "Electro-Diagnosis of War," Prof. A. Zimmern and P. Perol, edited by Dr. E. P. Cumberbatch; "Disabilities of the Locomotor Apparatus: The Result of War Wounds," Prof. A. Broca, edited by Major-Gen. Sir R. Jones; and "Wounds of the Pleura and Lungs," Prof. R. Grégoire and Dr. Courcoux, edited by Lt.-Col. C. H. Fagge (*University of London Press, Ltd.*).

OUR ASTRONOMICAL COLUMN.

SCHORR'S COMET.—Messrs. Braae and Fischer-Petersen have recomputed the orbit of this comet, using observations extending from November 23 to December 10. They find that it is a periodic comet belonging to the Jupiter group.

$$T = 1918 \text{ Sept. } 27{\cdot}5834 \text{ G.M.T.}$$
$$\left.\begin{array}{l}\omega = 278^\circ\ 8'\ 11{\cdot}6''\\ \Omega = 117^\circ\ 56'\ 28{\cdot}2''\\ i = 5^\circ\ 35'\ 16{\cdot}3''\end{array}\right\}1918{\cdot}0$$
$$\phi = 28^\circ\ 10'\ 46{\cdot}9''$$
$$\log a = 0{\cdot}551909$$
$$\text{Period} = 6{\cdot}72764 \text{ years.}$$

Ephemeris for Greenwich Midnight.

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
January 7	3 57 34	14 46·9		
11	3 59 1	15 12·4	0·3187	0·1177
15	4 0 56	15 38·5		
19	4 3 18	16 5·0	0·3246	0·1487
23	4 6 6	16 31·5		
27	4 9 19	16 58·1	0·3308	0·1798
31	4 12 54	17 24·6		
February 4	4 16 50	17 50·8	0·3370	0·2106

OPPOSITION OF JUNO.—Juno will be in opposition on January 20, its magnitude being 7·8. The following ephemeris is from the Circular of the Berlin Rechen-Institut:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
January 5	8 20 53	0 49	0·344	
13	8 14 11	1 32		0·108
21	8 6 59	2 32		0·110
29	7 59 59	3 44		0·117
February 6	7 53 53	5 4		0·130
14	7 49 11	6 27	0·363	

TWELVE NEW SPECTROSCOPIC BINARIES.—In a communication to the Journal of the Royal Astronomical Society of Canada (vol. xii., p. 460) Dr. J. S. Plaskett gives particulars of the first twelve spectroscopic binaries which have been discovered with the aid of the new 6-ft. reflecting telescope of the Dominion Astrophysical Observatory at Victoria, B.C. The variable velocities of these stars were detected in the course of the measurement of some of the 750 spectra secured between the arrival of the mirror at the observatory on April 29 and the third week in October. The magnitudes of the stars involved range from 5·0 to 6·32, and it would thus appear that very rapid progress in this field of observation may now be expected. The two stars Boss 4870 and Boss 5236, which are assigned to class A by the Harvard observers, have been found to be of early B type.

THE MINOR PLANET 692 HIPPODAMIA.—This small planet has given a good deal of trouble to those who have endeavoured to follow its movements. Both the eccentricity and inclination are large, the declination at opposition ranging from +51° to −49°, and the magnitude from 12·3 to 14·1. The planet was observed in 1902 and 1911, but sought unsuccessfully in 1915. M. H. Dubosq-Lettré gives new orbit elements in the *Journal des Observateurs* (vol. ii., No. 11), and appeals to observers to search for it.

OBSERVATIONS OF EROS.—The *Journal des Observateurs* (vol. ii., No. 11) contains a series of photographic observations of 433 Eros, made in 1917 at the Cape Observatory by Mr. J. Voûte. Owing to its high south declination (about 50°) the planet was invisible in Europe. It will again be in opposition next summer, but, being near aphelion, it will be faint.

PARIS ACADEMY OF SCIENCES.

Prizes Proposed for 1920.

THOSE prizes marked with an asterisk are without restriction of nationality.

Mathematics.—* Poncelet prize (2000 francs), for the author of the work most useful to the progress of pure mathematics; Francœur prize (1000 francs), for similar work in pure or applied mathematics.

Mechanics.—Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, and practical and theoretical sciences; Fourneyron prize (1000 francs), subject proposed: The theoretical and experimental study of the question of internal-combustion turbines; Henri de Parville prize (1500 francs), for original work in mechanics.

Astronomy.—* Lalande prize (540 francs, a gold medal, or its value), for the author of the most interesting observation or work most useful to the progress of astronomy; Damoiseau prize (2000 francs), question proposed: To improve in some important points the works of Poincaré and of Liapounoff on the figures of equilibrium relating to a fluid mass in rotation submitted to the Newtonian attraction. The Academy specially directs attention to the question of stability and the study of the infinitely small oscillations round a stable figure. The question set for 1917 is given again for 1920, to calculate more exactly, taking account of the results of recent expeditions, the attraction of the moon on the raised ring formed at the surface of the earth by the tides. To examine the effect of this attraction on the angular velocity of rotation of the earth; Benjamin Valz prize (460 francs), for work on astronomy conforming to the conditions for the Lalande prize; the * Janssen prize (a gold medal), for the author of a work or discovery constituting direct progress in the field of physical astronomy; * Pierre Guzman prize (100,000 francs), to anyone finding a means of opening communication with a planet (excluding Mars). Failing solution, the interest will be awarded for real and serious progress, either in the knowledge of the planets of the solar system, or in the relations of the planets of this system with the earth, by means of improved physical or optical instruments, or by any other mode of inspection or investigation.

Geography.—Delalande-Guérineau prize (1000 francs), for a French traveller or savant whose work has been the most useful to France or to science; Gay prize (1500 francs), question proposed: The geographical distribution of tropical plants presenting a practical utility; * Tchihatchef foundation (3000 francs), as recompense for or assistance to naturalists distinguished in the exploration of the Asiatic continent or adjacent islands, especially the lesser-known regions (British India, Siberia, Asia Minor, and Syria excluded). The explorations may have as object any branch of the natural, physical, or mathematical sciences, but such sciences as archæology, history, ethnography, and philology are excluded. The work must be the result of personal observation; Binoux prize (2000 francs), for the author of works on geography or navigation.

Navigation.—Prize of 6000 francs, as a recompense for progress increasing the efficiency of the French naval forces; Plumey prize (4000 francs), for the author of an improvement in steam-engines, or any other invention contributing most to the progress of steam navigation.

Physics.—* L. La Caze prize (10,000 francs), for the best work on physics; Hébert prize (1000 francs), for the author of the best treatise or most useful discovery for the popularisation and practical employment of electricity; Hughes prize (2500 francs), for the author of an original discovery in physical science, especially electricity and magnetism or their applications; Clément Félix foundation (2500 francs, undivided), for a Frenchman devoting himself to the study of electricity, and, having already furnished proofs of ability, to facilitate the continuation of his researches.

Chemistry.—Montyon prize, unhealthy trades (2500 francs, a mention of 1500 francs), for the discovery of a means of rendering some mechanical art less unhealthy; Jecker prize (10,000 francs), for the author of the most useful work on organic chemistry; * L. La Caze prize (10,000 francs, undivided), for the best work in chemistry; Cahours prize (3000 francs), for the encouragement of young men already known by their work, particularly by chemical researches; Houzeau prize (700 francs), for a young deserving chemist.

Mineralogy and Geology.—Fontannes prize (2000 francs), to the author of the best palæontological publication; Victor Raulin prize (1500 francs), restricted to authors of French nationality for facilitating the publication of works relating to mineralogy and petrography.

Botany.—* Desmazières prize (1600 francs), for the best or most useful work on cryptogams; Montagne prize (1500 francs), for important discoveries or works on the cellular plants; de Coincy prize (900 francs), for a work on phanerogams, written in Latin or French.

Anatomy and Zoology.—Cuvier prize (1500 francs), for work in anatomy and zoology; Savigny foundation (1500 francs), for the assistance of young travelling zoologists, not in receipt of Government grants, who specially occupy themselves with the invertebrate animals of Egypt and Syria.

Medicine and Surgery.—Montyon prize (three prizes of 2500 francs, three honourable mentions of 1500 francs, citations), for improvements in medicine and surgery; Barbier prize (2000 francs), for a valuable discovery in surgery, medicine, pharmacy, or botany having relation to the art of healing; Bréant prize (100,000 francs), for the discovery of a means of curing or eradicating Asiatic cholera. Failing this award, the interest will be given to anyone advancing science on the question of cholera or any other epidemic disease; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; Mège prize (10,000 francs), for the author who shall continue and complete the essay of Dr. Mège on the causes which have favoured or retarded the progress of medicine. The interest may be disposed of by the Academy until such time as it thinks fits to award the prize; Dusgate prize (2500 francs), to the author of the best work on the diagnostic signs of death, and on the best means of preventing premature burial; Bellion prize (1400 francs), for work or discoveries profitable to the health of man or the amelioration of the human species; Baron Larrey prize (750 francs), for a doctor or surgeon (Army or Navy) for the best work presented to the Academy in the course of the year dealing with military medicine, surgery, or hygiene.

Physiology.—Montyon prize (750 francs), for the most useful work on experimental physiology; Lallemand prize (1800 francs), for work relating to the nervous system in the widest sense of the words; * L. La Caze prize (10,000 francs, undivided), for work contributing to the progress of physiology; Martin-Damourette prize (1400 francs), for work in therapeutic physiology; Philipeaux prize (900 francs), for experimental physiology.

Statistics.—Montyon prize (1000 francs, two mentions of 500 francs), for statistical research in any field.

History and Philosophy of Science.—Binoux prize (2000 francs).

Medals.—Arago medal, awarded by the Academy for a scientific discovery of outstanding merit; Lavoisier medal, for eminent services in chemistry; Berthelot medals, awarded annually to the recipients of prizes in chemistry.

General Prizes.—Prize founded by the State (3000 francs), subject proposed for 1920: To improve the theory of functions of a variable susceptible of representations by trigonometric series of several arguments, linear functions of this variable; Bordin prize (3000 francs), subject proposed: Study of the sedimentary breccias; Serres prize (7500 francs), for general embryology applied so far as possible to physiology and medicine; Houllevigue prize (5000 francs), for work in the physical sciences; Saintour prize (3000 francs), for the same; Henri de Parville prize (1500 francs), for a book on original science or scientific popularisation; Lonchampt prize (4000 francs), to the author of the best memoir on the diseases of man, animals, and plants, especially from the point of view of the introduction of mineral substances in excess as the cause of these diseases; *Henry Wilde prize (4000 francs), for discovery or work in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Caméré prize (4000 francs), for a French engineer who has personally conceived, studied, and realised a work the use of which results in progress in the art of construction; Gustave Roux prize (1000 francs, undivided); Thorlet prize (1600 francs).

Special Foundations.—Lannelongue foundation (2000 francs), for the assistance of one or two persons in needy circumstances connected with the scientific world.

Prix des Grandes Ecoles.—Laplace prize (works of Laplace), to the student leaving the Ecole Polytechnique with the first place; L.-E. Rivot prize (2500 francs), between the four students leaving each year the Ecole Polytechnique with first and second places in the *corps des mines* and the *ponts et chaussées.*

Foundations for Scientific Research.—Trémont foundation (1000 francs), for assisting work useful to France; Gegner foundation (4000 francs), to assist a struggling scientific man already known by his work; Jérome Ponti foundation (3500 francs), for work in physical science; Henri Becquerel foundation (3000 francs), to be used for furthering the progress of science; Bonaparte fund (minimum grant 2000 francs), for facilitating researches by workers known by their original publications, and who lack sufficient researches to undertake or continue their investigations; Loutreuil foundation (125,000 francs), for encouraging the progress of science in colleges in Paris and the provinces (excluding the universities), as well as by independent workers, the creation and equipment of laboratories, the development of collections, libraries, scientific publications, and scientific expeditions.

THE ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS.

THE nineteenth annual general meeting of this association was held at the London Day Training College on December 31 and January 1. During the discussions the predominant topic was the danger of undue specialisation on the part of boys at school. It was refreshing to notice that science masters do not merely grumble at the unfair amount of time devoted to the more deep-rooted subjects of school curricula, but also recognise the error of early specialisation within their own subject. This note was struck by Sir Ronald Ross, who presided throughout the meeting. In his opening address (the main part of which appears elsewhere in this issue) he said that it was not only in their classical studies that the boys were kept too long pottering about the porch of the temple; that error also lies in attempting too much detail at the outset.

The recent meetings of the association have shown that more and more importance is being given to breadth of view in the teaching of science to young boys. There is a breaking away from the traditional chemistry, heat and light, as the only suitable scientific food for the young. Mr. W. D. Eggar said that at Eton College the experiment had been tried of making the classical masters responsible for some of the science teaching in the lower parts of the school. During the past term astronomy had provided the subject-matter, and he was well satisfied with the work that had been done. In the course of the discussion which followed Mr. Eggar's speech there were frequent expressions of dissatisfaction with the new regulations of the Oxford and Cambridge Joint Examining Board for the School Certificate Examination. A resolution was passed that the syllabus should be broadened by the inclusion of an alternative paper on general science.

The Rev. S. A. McDowall spoke of the science taught to the classical Sixth Forms at Winchester College. By the time the boys have reached this eminence they have spent some years in learning the grammar of science. Then the attempt is made to co-ordinate their knowledge, to draw general conclusions, and to learn something of the philosophy of science. "The aim is," to quote Mr. McDowall's words, "that the boy shall leave school with a certain power of detached judgment and criticism; that his attitude to the experiences of his ordinary life shall be a scientific one; and that he shall feel that physical and chemical facts underlie human activities and human problems."

Mr. F. S. Young, headmaster of Bishop's Stortford College, urged the importance of restricting specialisation in examinations for scholarships at the universities. The present system, he said, led to narrowness of outlook. He suggested that candidates should not be admitted to such examinations unless they had shown evidence of a satisfactory general education; that they should be required to offer subjects both cognate with and subsidiary to their main one; and that their performance in these should be considered fully in the awarding of scholarships. Mr. A. Hutchinson (Pembroke College, Cambridge) said that when the present system of scholarship examinations originated, education at the public schools was synonymous with specialisation in classics. He thought that even under present conditions candidates for science scholarships were less specialised than their classical and mathematical brethren, as they had for the most part a considerable mathematical equipment in addition to their knowledge of science. At Cambridge, he said, great care was now taken that candidates who offered two subjects, *e.g.* history and modern languages, were given full credit for their work, even if they failed to reach in either subject the standard attained by candidates who offered one subject only. Prof. A. C. Seward (Master of Downing College, Cambridge) said that at present the standards required in the candidates' special subjects were far too high, and that, so far, the means applied for testing the general knowledge of the candidates had, for the most part, been farcical. Col. A. Smithells (professor of chemistry, University of Leeds) considered that the difficulty had been met in his own university by bringing the award of scholarships within the domain of the Joint Matriculation Board, higher papers being set for this special purpose. The good working of the system, he said, was owing to the fact that the Matriculation Board contained a substantial body of representatives of the schools.

In connection with the meetings there was an exhibition of apparatus, etc. Perhaps the most important thing shown was the use of crystal violet to compare the hydrion content of aqueous solutions of acids by the colours obtained on adding measured proportions of the dye. The "weaker" the acid, the nearer is the tint to the violet end of the spectrum. Mr. R. G. Durrant (Marlborough College) claims that the margin of error in comparison with conductivity data is very narrow, and that his method is both simple and quick. Mr. Durrant also showed the use of malachite-green solution in differentiating the flames of the alkali and alkaline earth metals by cutting out the orange band from the spectrum; by this means the calcium flame appears bright green and the strontium one ruby-red.

During the nineteen years of its life the membership of the association has been restricted to the public schools. The basis has now been broadened so as to include science masters in any secondary school which is under the control of a corporate body. The name has therefore been changed to "The Science Masters' Association." Mr. W. D. Eggar, of Eton College, and Capt. W. J. R. Calvert, of Harrow School, are the new secretaries. Mr. W. W. Vaughan, the Master of Wellington College, was elected president of the association for the coming year.

MR. FISHER AND THE BOARD OF EDUCATION.

MR. LLOYD GEORGE is presumably busy forming his new Government, and rumour has it that many changes of *personnel* are imminent. Some two years ago, on the formation of the second Coalition Government, a novel departure was made under the stress of war conditions in the selection of men for certain appointments, not in virtue of political services for which due reward must be found, but in respect of peculiar fitness and proved experience of the work to be done. Among those invited to accept office was Mr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield, who had won the confidence of all classes in the area covered by the operations of the University by the tact, judgment, and broad sympathy with all forms of education he had displayed in the discharge of his duties. He was invited by Mr. Lloyd George to accept the Presidency of the Board of Education vacated by Lord Crewe, and he consented, a seat in the House being found for him in the Hallam division of Sheffield. Mr. Fisher has proved a success, not merely in the discharge of his duties as President, but also in the advocacy of a far-reaching, not to say revolutionary, Education Act, and of a measure of long-delayed justice to the teachers in the shape of a Superannuation Act, which will go far to make the profession of the teacher attractive. He has won golden opinions by the skill and judgment he displayed in piloting these measures through the House, and he has breathed a new atmosphere into the Board of Education which "brings hope with it and forward-looking thoughts." These two measures stand to his infinite credit; they still need careful guidance in order to reap their full fruit and to make way for further developments; and yet it is said that a change in Mr. Fisher's position is imminent, born of his very success. No department of the State has suffered more than that of education by the constant changes of its chief—there have been no fewer than ten since 1902—but it would not be so were its status and its vital importance to the national well-being rightly regarded. It ought to rank with the highest Cabinet offices, and be remunerated accordingly. It demands special knowledge and experience for its due discharge, and in Mr. Fisher we have the man who rejoices in both, united with an enthusiasm and devotion but rarely witnessed. That he should be assigned some other duties in the political sphere would excite a feeling of grave disappointment throughout the country at this critical time.

At the annual meeting of the Incorporated Association of Headmasters on January 3, the president of the association, Mr. F. B. Malim, Master of Haileybury College, proposed, and the Rev. Dr. David, Headmaster of Rugby, seconded, the following resolution, which was adopted unanimously:—"That this association desires to express its profound satisfaction at the educational developments initiated and carried by Mr. Fisher as Minister of Education, and its conviction that it is of the first importance in the interests of the nation that Mr. Fisher should continue in that office and should be enabled to complete the great work of which he has made so admirable a beginning; and that this association would regard it as a national calamity if Mr. Fisher should be required to leave the Board of Education at this juncture."

Following the headmasters' lead, the teachers assembled at the joint conference of educational associations at University College, London, on January 4, carried unanimously a resolution in the same sense, which was proposed by Sir Henry Hadow and seconded by Miss Busk. The motion was in the following words:—"This conference, composed of thirty-nine educational associations, which is now assembled at University College, London, wishes to urge the importance of retaining Mr. Fisher as Minister of Education. The educational developments accomplished by him during his period of office have given profound satisfaction to the teaching profession. Further, the confidence established between the Board of Education and teachers through Mr. Fisher's appointment and achievements has inspired teachers with a high sense of their responsibility in the training of the youth of the nation, and it is of the utmost importance that this confidence should be maintained and strengthened by the continuance of Mr. Fisher in the office of Minister of Education."

OBSERVATIONS ON THE RESULTS OF OUR SYSTEM OF EDUCATION.[1]

MANY problems of education would be solved if a really good scientific test of the results of education could be invented. I can imagine that if such a test were to be applied, say, once a year to all the forty million or so residents in this country, beginning with the British workman and ascending, or descending, to the Houses of Parliament, and even to the Royal Society, the results might be surprising. But as no such test is known, all we can do is to try to form some kind of personal estimate and integration, just as we try to measure lengths and areas by the eye—a method full of fallacies, but unfortunately, perhaps, the only one available. I propose, therefore, to offer for your consideration, as briefly as possible, my own life-notes on the subject.

Let us begin with physical education. Here, I think, the British system has deservedly set the fashion throughout the world. The young men of most coun-

[1] From the presidential address delivered at the annual meeting of the Association of Public School Science Masters on December 31, 1918, by Col. Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S.

tries have certain national games, but since the time of the ancient Greeks no nation has so assiduously practised in the whole field of bodily exercise—very much, in my opinion, to our advantage. That field is a very large one—first, the great natural exercises, running, swimming, rowing, riding, and climbing; secondly, the games, cricket, football, tennis, polo, and others; thirdly, the sports, fishing, shooting, and hunting; fourthly, special kinds of muscular training, such as gymnastics, boxing, and fencing; and, fifthly, military training. Now all these are invaluable, not only for the body, not only to maintain the *mens sana in corpore sano*, but also as exercises for most of the faculties of the mind and spirit. For this reason I attach the least value to the artificial exercises, so popular on the Continent, as gymnastics and fencing; and not so much to the games as to the natural exercises and sports. It has been the great merit of British education to have discovered the superlative educating capacity of what are often called mere pastimes and amusements. Yet this has been quite a modern discovery, and many nations are still only just learning the lesson from us. When I read Russian and French novels, and even some works of Dickens and other English writers, I seem to be living in a museum of pathological specimens, and not among men and women who have breathed God's air and seen the sunlight.

This leads to the all-important question of human physique—too large a theme for discussion now. But from my own observations made in many countries I conclude that variations in physique show such peculiar local distribution that we must attribute them more to environment than to heredity. What the principal cause of physical deterioration, combined as it generally is with mental and moral deterioration, may be escapes me. It cannot be entirely disease, or alcoholism, or underfeeding, or overcrowding, or climate, but must be some unknown factor which has not yet been discovered. On the other hand, speaking as a military medical officer, I will say with certainty that a period of open-air military training under discipline, combined with good food, greatly improves the physique, the health, and the mental powers of young men, let alone their manners and *morale*. For this reason I should be in favour of universal military training everywhere; but, on the other hand, I admit the force of the argument that such military training may be an incentive to puerile wars—though I am not sure of it. On the whole, therefore, I would at least suggest an alternative scheme—that is, a scheme of what I call "health conscription," consisting of at least a fortnight's compulsory physical training, under discipline, in the open air, for both sexes every year for five years between the ages, say, of fifteen and twenty. There will, of course, be the usual objections on the score of expense and interference with so-called liberty; but the alternative appears to me to be continued deterioration of body and mind. The public schools of Britain have set the example in what may be called physical religion; my proposal is merely to extend that faith to all classes.

Coming now to the actual knowledge obtained by the young in our schools, I have concluded that it is really not very much. My complaint (and that of others) is not so much as to the total amount of information imparted as to the direction of it. As everyone knows, our teaching has been concerned chiefly with mathematics and the classics, with the outlines of history and of English literature. First taking mathematics (which is a hobby of mine), my observation is that few young men know even the aims and objects of the science, much less its applications, although they may have studied it for years at school. If you ask them they will reply, "Mathematics is doubtless very fine, but I don't know what the dickens it is all about; and, anyway, it is no use to me." The reason for this is that the schoolboy is not pushed fast enough into the heart of the science, which is the calculus. He is kept, so to speak, pottering about with petty problems in the porch of the temple, and is never allowed to look into the temple itself and to see the beauties within. In fact, the whole subject is taught, not as a great science, but as an opportunity for exercising the mind by a system of puzzles. The error is that of entering into too great detail at the outset. Instead of climbing the mountain, we are kept wandering among the boulders at its base; we become tired; we abandon our enterprise; and the time and money spent on it are almost entirely wasted. I once wished to give a simple mathematical demonstration to a class of more than twenty medical officers; only one of them knew the meaning of a differential coefficient!

As regards the classics, my complaint is, not that boys are taught the "humanities," but that they are *not* taught them. The fundamental mistake seems to be the same as in mathematics—too great detail at the outset. The study of the history, literature, art, and policies of the human race degenerates into the meticulous study of the alphabet of the subject only—that is, Greek and Latin grammar. Why do we still learn these languages? In order to read Greek and Latin literature. But after we have spent years in learning the languages, we become so tired of them that we do not read the literature at all! I am a bad linguist, but an ardent admirer of classical literature; yet when I was a young man I noted that many of my friends were good linguists, but hated the literature. Surely a waste of time and money again. The book is opened; a few words are deciphered; the scholium is read; and the book is closed again—and for ever.

So also with our teaching in most things—we potter about the porch and never look into the temple at all. How often, for example, are our boys taken into the picture galleries, those great temples of the human spirit, and there taught the history and the meaning of the art enshrined in them? Or how often are they taken to hear the reading of our own national poems or the music of the great composers? Seldom, I think; and when they escape from school they take to the reading of shilling novels and the viewing of contemptible plays.

It is usually, and rightly, maintained that the aim of all education is to endow the young with character, judgment, and knowledge; but when people argue that the relative importance of these qualities is in the order given—that character comes first, then judgment, and lastly knowledge—I am inclined to disagree. We have here, indeed, a trinity of elements all necessary for educational salvation, but all three are so closely knit together that we cannot do without one of them. Without character one can possess neither judgment nor knowledge; without judgment, neither character nor knowledge; without knowledge, neither character nor judgment. How, for instance, may a person who consents to remain ignorant of all the knowledge which science has given to us be said to possess character? And as for judgment, it is not a faculty bestowed upon us *a priori* at birth, but one which grows with exercise. Shelley fixed the argument when he said of one of the highest virtues:

> Love is like understanding, that grows bright
> Gazing on many truths.

Similarly, breathing, sleep, and food are all necessary for bodily salvation; and one might as well say that the relative importance of these is in the order named. The point is worth noting, because it has become the fashion lately to decry knowledge especially. "Be good," says one, "and let who will be wise"; and Tennyson exclaims of knowledge, "Let her know her place; she is the second, not the first."

Such sayings are based upon a false psychology; for the mind is not a thing of only one or two dimensions, but of three, and there is no first and no second where all three are equal. One might as well say, "It is nobler to breathe and to sleep than to eat; therefore let us do without food." And, indeed, this is the actual faith of the Indian fakir, leading to a futile philosophy which was becoming very prevalent even in this country before the war, and which I called "fakirism." When this evil spirit enters into the mind of a nation, that nation is doomed. Like the Indian fakir, it will be content to sit by the roadside of life and to achieve nothing thereafter except the pursuit of idle dreams, as many nations have done and are doing. It is your mission, I take it, to contend against this spirit, to rouse the fakir, and to put some of the abhorred beef and bread of natural science into him, so that he shall begin to do honest work again.

All this is really very pertinent to our theme. For if knowledge is of no account, why trouble to teach any at all? But if it is of some account, then why not teach knowledge that is useful as well as sound? But here we strike at once across two dogmas which I have often seen repeated in educational literature. The first is that the object of education is not to impart knowledge, but to exercise the mind in the art of acquiring knowledge for itself in after-years. There is some truth in that, but also a fallacy. For how can we exercise a mind in the art of acquiring knowledge except by the practice of that art? We might as well try to teach a boy to swim without putting him in the water. Then there is the second dogma, which is just the opposite—that what is taught at all must be taught thoroughly. Now I am no teacher of young boys myself, but I doubt the policy. I think that it is advocated in disregard of the natural law that living beings tend to hate a food which is offered to them too constantly. Moreover. we can never know in which direction a boy's aptitude really lies; and, lastly, it is impossible to teach anything thoroughly to anyone, for all knowledge is infinite. I conclude, therefore (though I may be wrong), that it is not good to bury a youth at the bottom of a mine in order that he shall search there for some gold which perhaps he will never find; but that it is better to take him speedily to a height whence he can survey the whole world and choose for himself the field for his own future work.

Neither you nor I will pretend that natural science is to be the only subject to be taught; but I cannot conceive how anyone who does not possess some broad knowledge of the immense accumulation of facts about Nature collected by humanity during the last two thousand years can dare to call himself an educated person. Some years ago a headmaster whose name I have forgotten maintained that a study of the stars is unimportant for men. He meant, not men, but earthworms. A man is, or ought to be, something more than an animal, and the very definition of him is that he *shall* study the stars.

Of course, in this very brief survey I have been obliged to omit reference to some points even of the first importance, such as manners and *morale*, for instance; and to exclude university education, which is the privilege only of a few persons. I will conclude now with the following summary of my own opinions—for what they are worth. I think that our system of open-air education, in which the public schools set the example, is a most invaluable and essential part of education. Closely connected with it is the principle of personal honour, good temper, and duty—that is, a spirit of *noblesse oblige*, which that open-air education, more than anything else, fosters and inculcates. On the other hand, I think that our system of education is defective as regards the imparting of fundamental knowledge. Most of the great knowledges of humanity are not implanted in the minds of our youth—not only the great discoveries of science, but also the great discoveries of literature, including classical literature, and of the high poetry, painting, music, and philosophy, which constitute the principal heritage of the human race. Indeed, knowledge is often actually derided by the numerous apostles of "fakirism" in this country, or replaced by a useless lumber of unimportant matter; and foreign languages and many of the petty but useful arts of life are much neglected. Hence the whole intellectual side of life is too frequently ignored, or even despised, by the masses of the people, with the result that their judgment is starved for lack of facts, and that they become too often the slaves of fads and quackeries and unproven dogmas of every description—party politics, meretricious propagandas, ignoble creeds, and even sometimes superstitions that savages would laugh at. But behind these and other defects the nation possesses by nature a kindliness, a sense of humour and fair play, and an unopposable force of good intention which have made it during the last four years the pattern and exemplar of the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. M. C. RAYNER has resigned her appointment as lecturer in botany (lecturer-in-charge) at University College, Reading.

DR. R. M. CAVAN, of the chemistry department of University College, Nottingham, is leaving shortly to take up his duties as principal of the Technical College, Darlington.

THE sum of 3000*l.* has been given by Mr. G. T. Hawkins, of Northampton, towards the building and equipment of a pathological laboratory at the Northampton General Hospital.

MR. W. H. WATSON, of the chemistry department of the Northern Polytechnic Institute, has been appointed vice-principal and head of the chemistry and natural science department of the Municipal College, Portsmouth.

THE organised laundry trade is establishing a research department, the object being to increase efficiency through science and invention, and towards this a Croydon launderer has offered 100*l.* and 50*l.* yearly for five years.

Two Theresa Seessel research fellowships, each of the value of 200*l.*, are being offered by Yale University. The fellowships are intended to promote original research in biological studies, and are open to men or women. Applications, accompanied by reprints of scientific publications, letters of recommendation, and a statement of the particular problem which the candidate is prepared to investigate, must be made before April 1 next to the Dean of the Graduate School, New Haven, Conn., U.S.A.

GOOD progress has been made in the formation of the Society of British Science Students, to the inauguration of which attention has been directed already in these columns. A temporary executive has been elected, of which Mr. P. E. Owens, 28 Jesse

Terrace, Castle Hill, Reading, is the hon. secretary. The principal object of the society is to strengthen the relations between the younger students of science in this country by means of meetings, lectures, and publications, and by other suitable measures. The society will endeavour to secure privileges for its members in regard to other societies and to circulate information among the members relating to scholarships, vacant appointments, and so on. All inquiries should be addressed to the hon. secretary.

THE *Publishers' Circular and Booksellers' Record* records a total of 7716 books as having been published during the year 1918. This is a decrease of 415 compared with the previous year, and it is accounted for chiefly by a falling off in the number of works of fiction (−523) and juvenile literature (−155); other classes that have also decreased slightly are education, agriculture, domestic, business, history, and geography. On the other hand, sociology has increased by 112, technology by 110, medicine by 80, and poetry by 98. Under "Science" the number of new books recorded is 232, also 5 translations and 28 pamphlets. In addition, there were 64 new editions, making a total of 329. In the year 1914 science occupied the third place in twelve classes of literature, and technology the fifth place; in 1918 technology was in the eighth place and science in the tenth.

A COURSE of nine lectures on dynamical meteorology will be given at the Meteorological Office, South Kensington, by Sir Napier Shaw, reader in meteorology in the University of London, on Fridays, at 3 p.m., beginning on January 24. Each lecture will be followed by a conversation class for the discussion of practical details and of references to the original sources of information. The informal meetings at the Meteorological Office for the discussion of important current contributions to meteorology, chiefly in Colonial or foreign journals, will be resumed at 5 p.m. on Monday, April 28, and will be continued on each Monday until June 23, with the exception of June 9. Students wishing to attend should communicate with Sir Napier Shaw. The lectures are intended for advanced students of the University of London and others interested in the subject. Admission is free by ticket, obtainable on application at the Meteorological Office.

THE London County Council has arranged a series of special lectures for teachers, on subjects connected with problems of reconstruction, for the spring and summer terms of the present year. Full particulars are contained in the "Handbook of Classes and Lectures for Teachers" published by the Council. Among the numerous courses of lectures the following may be mentioned: the last three of the series on "Science and the Nation," viz. engineering, with special reference to its relations with our national life, by Prof. W. E. Dalby, at 11 a.m. on January 25, at the City and Guilds Engineering College of the Imperial College of Science and Technology, South Kensington; pure science in relation to the national life, by Prof. A. Schuster, at 11 a.m. on February 15, at the Regent Street Polytechnic, W.1; some aspects of the rubber-growing industry, by Prof. J. B. Farmer, at 11 a.m. on March 8, at the Regent Street Polytechnic, W.1. At King's College, Strand, on Wednesdays, at 5.30 p.m., beginning on February 5, a course of public lectures on "Physiology and National Needs" will be delivered. The lectures include physiology and the food problem, by Prof. W. D. Halliburton; physical training of the open-air life, by Dr. M. S. Pembrey; "vitamines"—unknown but essential accessory factors in diet, by Prof. F. G. Hopkins; scurvy—a disease due to the absence of vitamine, by Prof. A. Harden; physiology and the study of disease, by Prof. D. N. Paton; and conservation of our cereal reserves, by Prof. A. Dendy. Applications for admission to these lectures should be addressed direct to the secretary of the college.

THIS year's educational gatherings included a joint meeting on January 2 of the Headmasters' Conference and the Incorporated Association of Headmasters, at which the reports of the Government Committees on science and modern languages were considered. After some discussion the following resolutions, dealing with the teaching of science and mathematics, were adopted by the conference:—(1) That suitable instruction in natural science should be included in the curriculum of preparatory schools, of the upper standards of elementary schools, and of all boys in public and other secondary schools up to the age of about sixteen. (2) That mathematics and natural science should be necessary subjects in the entrance scholarship examinations of public schools, in the first school examination, and in the examinations for entrance into the Navy and the Army, provided that good work in other subjects should compensate for comparative weakness in mathematics and natural science. (3) That for boys between twelve and sixteen the teaching of natural science should not be confined to physics and chemistry, but should include some study of plant and animal life, and that more attention should be directed to those aspects of science which bear directly upon the objects and experience of everyday life. (4) That there should be as close correlation as possible between the teaching of mathematics and of science. After a discussion of the report on the teaching of modern languages the conference passed resolutions, among others, declaring that the study of one or more languages other than English should be regarded as an essential part of higher education; that the first language other than English should be begun at about the age of ten, the second language not beginning until there was evidence of satisfactory progress in the first; and that usually the first language should be French and the second Latin.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 18, 1918.—Mr. G. W. Lamplugh, president, in the chair.—C. T. **Trechmann**: A bed of inter-Glacial loess and some pre-Glacial freshwater clays on the Durham coast. A few years ago the author described a bed of Scandinavian drift that was found filling up a small pre-Glacial valley-like depression at Warren House Gill, on the Durham coast. This section, and others north and south of it, have been kept under observation at different times, and several new features have been noticed as the high tides and other agencies exposed parts of the coast. All the observed features seem to point to the fact that the Scandinavian ice-sheet advanced on the east coast of England in the same way as it invaded northern Europe round the southern shores of the Baltic, and gave rise to analogous climatic conditions leading to the formation of loess, a fragment of which is found protected from the erosive action of the later local glaciation in a small hollow on the Durham coast.

PARIS.

Academy of Sciences, December 23, 1918.—M. P. Painlevé in the chair.—C. **Guichard**: A series of surfaces of constant total curvature such that their lines of curvature form a network of the type pA', $-pB'$.—M. Georges Charpy was elected a member of the division of the application of science to industry.—P. **Fatou**: Suites of analytical functions.—G. **Julia**: Surfaces defined by a kinematic property.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the second quarter of 1918. Summary of observations made on seventy-seven days of the spots, their distribution in latitude, and the distribution of the faculæ in latitude.—E. **Belot**: The *rôle* of the satellite material in the structure of the surfaces of the earth, the planets, and the sun.—A. **Portevin**: Comparison between the internal elastic equilibrium of alloys after tempering and after hardening by drawing in the cold. A comparison of the internal strains developed in a 60/40 brass by tempering at 760° C. in water and by wire-drawing.—MM. R. **Dubrisay**, **Tripier**, and **Toquet**: The miscibility of phenol and alkaline liquids. The relation between the temperature of complete miscibility of phenol and alkaline solutions of varying concentrations has been studied and the results given graphically.—L. F. **Navarro**: The constitution of the Island of Gomera (Canary Islands).—A. **Vacher**: The morphogeny of the roadstead of Brest.—P. **Pruvost**: The fossil fishes of the Coal Measures of the North of France.—M. **Molliard**: The influence of certain conditions on the comparative consumption of glucose and levulose by *Sterigmatocystis nigra* starting from saccharose.—A. **Paillot**: Some new parasitic coccobacilli of the cockchafer.

BOOKS RECEIVED.

Man's Redemption of Man: A Lay Sermon. By William Osler. Reprint. Pp. 63. (London: Constable and Co., Ltd.) 7*d.* net.

Chemistry Notes and Papers for School Use. (Notes and Question Papers to Supplement the Pupil's own Laboratory Notes.) Part i.: Introductory and First-year Work. In nine sections—A to I. Pp. 114. Part ii.: Second-year Work. In seven sections—A to G. Pp. 101. Part iii.: Third-year Work. In eight sections—A to H. Pp. 123. By G. N. Pingriff. (London: "Geographia," Ltd.) 2*s.* 3*d.* net each part.

A School Chemistry Method: Being the Teacher's Supplement to Chemistry Notes and Papers. Parts i., ii., and iii. By G. N. Pingriff. Pp. xii+80. (London: "Geographia," Ltd.) 1*s.* 9*d.* net.

Afforestation. By John Boyd. Pp. 39. (London: W. and R. Chambers, Ltd.) 1*s.* net.

La Face de la Terre (Das Antlitz der Erde). By Prof. E. Suess. Traduit avec l'autorisation de l'auteur et annoté sous la direction de E. de Margerie. Tome iii., 4e Partie. Tables Générales de l'ouvrage. Tomes i.–iii. Pp. 258. (Paris: A. Colin.) 25 francs.

From Darwinism to Kaiserism. By Dr. R. Munro. Pp. xviii+175. (Glasgow: J. Maclehose and Sons.) 4*s.* net.

Intravenous Injection in Wound Shock. By Prof. W. M. Bayliss. Pp. xi+172. (London: Longmans and Co.) 9*s.* net.

Can We Compete? By G. E. Mappin. Pp. x+149. (London: Skeffington and Son, Ltd.) 4*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—M. B. Field: The Navigational (Magnetic) Compass as an Instrument of Precision.

OPTICAL SOCIETY, at 7.—Lt.-Col. A. C. Williams: The Design and Inspection of Certain Optical Munitions of War.

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Rev. A. L. Cortie: The Spectrum of Nova Aquilæ, 1918, June 15.—J. K. Fotheringham: The New Star of Hipparchus and the Dates of Birth and Accession of Mithridates.—Rev. J. G. Hagen: Observations of Nova Aquilæ, 1918.—A. Stanley Williams: The Variable Star B.D.+39°, 3476.

MONDAY, JANUARY 13.

ROYAL INSTITUTION, at 3.—Prof. Spenser Wilkinson: Lessons of the War.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—James Berry: Transylvania and its Relation to Ancient Dacia and Modern Rumania.

TUESDAY, JANUARY 14.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—A. G. Cooper: Slips and Subsidences on the Ceylon Government Railways.—F. W. Scott: Pietermaritzburg-Riet Spruit Deviation.

MINERALOGICAL SOCIETY, at 5.30.—A. Hutchinson: Stereoscopic Lantern-slides of Crystal Pictures.—L. J. Spencer: Mineralogical Characters of Turite (=Turgite) and some other Iron-ores from Nova Scotia.

WEDNESDAY, JANUARY 15.

ROYAL SOCIETY OF ARTS, at 4.30.—A. F. Kendrick: English Carpets.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard: Presidential Address: The Limitations of Microscopy.

THURSDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY OF ARTS, at 4.30.—H. Kelway-Bamber, M.V.O.: Coal and Mineral Traffic on the Indian Railways.

LINNEAN SOCIETY, at 5.—Capt. A. W. Hill: The Care of Soldiers' Graves.—N. E. Brown: Old and New Species of Mesembryanthemum, with Critical Remarks.—Dr. J. R. Leeson: Exhibition of Mycetozoa from Epping Forest.

CHEMICAL SOCIETY, at 8.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 5.30.—Sir J. Dewar: Liquid Air and the War.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, JANUARY 16, 1919.

CHEMISTRY FOR STUDENTS.

(1) *A Manual of Chemistry, Theoretical and Practical, Inorganic and Organic. Adapted to the Requirements of Students of Medicine.* By Dr. A. P. Luff and H. C. H. Candy. Sixth edition, enlarged. Pp. xix+745. (London: Cassell and Co., Ltd., 1918.) Price 12*s.* net.

(2) *Practical Chemistry for Intermediate Classes.* By Prof. H. B. Dunnicliff. Pp. xii+277. (London: Macmillan and Co., Ltd., 1917.) Price 5*s.*

(3) *The Ontario High School Laboratory Manual in Chemistry.* By George A. Cornish, assisted by Arthur Smith. Pp. vii+135. (Toronto: The Macmillan Co. of Canada, Ltd., 1917.) Price 25 cents.

(4) *The Ontario High School Chemistry.* By George A. Cornish, assisted by Arthur Smith. Pp. vii+297. (Toronto: The Macmillan Co. of Canada, Ltd., 1918.) Price 50 cents.

(5) *New Reduction Methods in Volumetric Analysis. A Monograph.* By Prof. Edmund Knecht and Eva Hibbert. Reissue with additions. Pp. x+135. (London: Longmans, Green, and Co., 1918.) Price 5*s.*, net.

MANUALS of chemistry that deal with the subject generally or in a specially practical manner are now so numerous, and perhaps we may add so similar, that it is not easy to discover the special advantages of each. Those before us are evidently all written by competent teachers who know their subject. As years go by there is a tendency, which is doubtless a very wholesome progress of development, to include more physical chemistry and more generalities, and we suppose that the time will come when general manuals will consist almost entirely of the exposition of such fundamental matters, leaving the detailed description of properties and specific changes to special sectional manuals and the larger works that aim at completeness.

(1) The volume by Dr. Luff and Mr. Candy, being a sixth edition, is well established and well known. Although specially designed for medical students, it will be found to be an excellent handbook for students of chemistry whatever their ultimate aim. In this edition more organic chemistry is included, and the practical section has been extended to meet the present requirements of students of medicine. The first hundred pages are devoted to generalities and laws, and these are set forth in a plain and straightforward, although concise, manner. The organic section fills rather more than two hundred pages. The practical section, occupying about sixty pages, includes such subjects as the preparation of salts and esters, qualitative analysis, including the identification of many organic substances, volumetric analysis, and the estimation of nitrogen, fat, urea, etc. This section is kept small by constant reference to the other part of the manual. The statement that aldehyde has a "characteristic fruity odour," although repeated, must have gained admittance by inadvertence.

(2) Prof. Dunnicliff's volume consists of directions for sixty-one "demonstrations," each of which has been found to occupy the student from $1\frac{1}{2}$ to $1\frac{3}{4}$ hours. The instructions are very clear and excellently illustrated. The subjects are well chosen, and include the preparation of common gases, acids, salts, etc., qualitative analysis, and volumetric analysis. Of course, there are experiments in which are measured the volumes of gases evolved in certain reactions, but we are glad to see that nothing is said as to the results confirming certain laws, because such results as students are able to get generally oblige them to choose between the truth of the law and the accuracy of the experiment, and it is often the law that suffers discredit.

(3) and (4) The two volumes from Toronto are very suitable for the purposes for which they are designed. The manual is unusually interesting, as historical details are given much more copiously than is often the case. Portraits of Cavendish, Priestley, Lavoisier, Dalton, Ramsay, Scheele, Faraday, and Davy are included, with a few lines of biographical details appended to each. Interest is well maintained by a facsimile of a page of Dalton's notebook, the figures of old apparatus, and of such modern matters as the cyanamide factory at Niagara Falls (which is stated to be the largest chemical industry in Canada), a liquid-air machine, a sectional view of a salt well and the brine-concentrating apparatus, Moissan's electric furnace, etc., all of which are shown so that their nature can be readily understood. The laboratory manual consists of seventy-five exercises, some of which are of more general interest than are often prescribed. But we hope that it is not usual in Canada to use alum as the acidifying agent in baking-powder, as one might be led to believe by its being given as an alternative to cream of tartar.

(5) The remaining volume, by Prof. Knecht and Eva Hibbert, is of quite a different character from the preceding. It is a monograph on the use of titanous chloride as a quantitative reducing agent. Although this salt is fairly easy to employ as a volumetric reagent, its great reducing power brings within its range of action a large number of substances of very various kinds. Its application is described to numerous metals, non-metallic elements and their compounds (per salts, chlorates, nitrates, hydroxylamine, and so on), and organic compounds such as nitro-compounds, nitroso-compounds, azo- and other dyes, and sugars. The estimation of certain dyes on dyed cotton fabrics is possible, and the degree of mercerisation in cotton yarns can be estimated by determining the proportion of Benzopurpurin 4 B taken up by the ordinary and by the mercerised cotton. It is a volume that should be at hand in all analytical laboratories.

C. J.

SCIENCE TEXT-BOOKS FOR THE FUTURE.

Manuale di Fisica ad Uso delle Scuole Secondarie e Superiori. Vol. iii. "Elettrologia." By Prof. B. Dessau. Pp. vii + 760. (Milano: Società Editrice Libraria, 1918.) Price 23 lire.

WHATEVER changes are introduced in our educational scheme in the near future, it may be taken as certain that physical science is destined to occupy a more prominent position in the schools. It is to be hoped, therefore, that science-teachers will rapidly come to some agreement concerning its scope and the general method of its presentation. To the present writer it seems evident that if the next generation is to possess a better appreciation than its predecessors of the possibilities of science as a means of enjoyment, a mental discipline, or an industrial power, science must be taught in a less detailed and more general manner than is at present customary. As Sir Napier Shaw has indicated, there must be less insistence on laboratory science in the schoolboy stage, and more emphasis on its applications to large-scale and natural phenomena and to recent discoveries. This may mean some missing links in the logic—which can be supplied, when necessary, at the university—but it will be balanced by a great increase in interest for both pupil and teacher. Obviously this will necessitate a radical revision of the present school text-books.

It was in the hope of obtaining some light on the nature of this revision that the book now under notice was opened, especially as it forms the third volume of a "Manual of Physics for the Use of Secondary and Higher Schools." To criticise a foreign text-book from such a point of view would, of course, be unfair; it may therefore at once be said that only two minor criticisms are called for. The first is that, considering its public, the book appears to be unnecessarily large and costly; the second, that some of the illustrations are so well-worn as to deserve a period of retirement. For example, induced currents are demonstrated by an astatic galvanometer and a Bunsen (or Daniell) cell, though probably no teacher would use this apparatus as the most convenient.

The book is written with all the literary charm, lucidity, and logicality of method that seem inseparable from French and Italian manuals; it is up to date in its matter, and is calculated to excite and hold the interest of the reader.

From the point of view indicated above, it may be noted that modern developments receive ample treatment; such are X-rays, radio-activity, telegraphy (wireless and otherwise), telephony, and machinery; even the constitution of the atoms and atmospheric electricity receive brief mention in the concluding pages. The order differs little from that adopted in English text-books; in this, perhaps, it is too conservative for a new model. For instance, there appears to be little reason why the idea of electrons should not be introduced at a much earlier stage, as is done in some American text-books; a stream of charged particles does, at least, give a student concrete ideas on the nature of a current, and makes electrostatic induction less hazy. As a model for future books in this country, the volume is too detailed and, except for those who intend to pursue the subject further, too mathematical to be copied.

In conclusion, one can but wonder when the pupils of our "secondary and higher schools" will be capable of reading such a volume with understanding and profit. R. S. W.

PLANTING IN MARITIME LOCALITIES.

Seaside Planting for Shelter, Ornament, and Profit. By A. D. Webster. Pp. 156. (London: T. Fisher Unwin, Ltd., 1918.) Price 18*s.* net.

THERE is no kind of planting which needs more careful study before it is undertaken than the planting of maritime situations. To all the problems that arise in inland localities in regard to soil, moisture, and exposure, there is added at the seaside the very momentous one of salt-laden spray. Winds, too, not only reach their maximum of violence on our shores; their mechanical effects are more persistent there than elsewhere. The best thing anyone contemplating an extensive scheme of planting near the sea can do is to make a thorough study of the problem by visiting places where it has been successfully solved. Such a place is the famous Holkham sands, in Norfolk, planted by the Earl of Leicester. Here an immense area of loose, shifting sands exposed to the full blasts from the North Sea has been clothed with a magnificent growth of pines and other trees. But, failing that, the next best thing is to obtain expert advice. The literature on the subject is not extensive, and we know no work that deals more satisfactorily with it than this new book by Mr. A. D. Webster. Mr. Webster's book is no mere *réchauffé* of what has been written before. It embodies the personal experience of one who has planned, superintended, and successfully achieved the planting of many seaside places. Besides the planting of trees and shrubs for utility and ornament, Mr. Webster deals also with the fixing of sand dunes by the use of marram grass and other plants. This question is of immense importance in connection with coast erosion and the smothering of fertile land by inblown sand.

The book is well printed and illustrated by some thirty half-tone plates, excellently reproduced. These pictures would, however, have been more convincing had they illustrated plantations and trees actually existing in maritime localities. Many of the photographs were taken in obviously inland sites. The plates bearing the legends "Laburnum by the Seaside," "Whitebeam at the Seaside," and "Stone Pine at the Seaside" are all of trees growing in Kew Gardens, which is scarcely a maritime locality. The picture entitled

"Weymouth Pine at Bournemouth" is also misleading. There are very few Weymouth pines (*Pinus strobus*) at Bournemouth, and those on the spot illustrated are almost exclusively *Pinus pinaster*, with a few Scotch pines mixed among them. W. J. B.

OUR BOOKSHELF.

British Rainfall, 1917: *On the Distribution of Rain in Space and Time over the British Isles during the Year* 1917. By Dr. H. R. Mill and C. Salter. Pp. 240. (London: Edward Stanford, Ltd., 1918.) Price 10*s*.

THIS is the fifty-seventh annual volume of "British Rainfall," and it is an exceedingly creditable piece of work for a private organisation, entirely without State aid. Records are given for upwards of 5000 stations, and every care has been taken to render the monthly and annual maps and tables complete, the curtailment due to the exigencies of the times being in the letterpress.

A small area near the estuary of the Thames had fewer than 150 rain days during the year, while over a large part of Scotland and Ireland, as well as in parts of South Wales and Lancashire, the rain days exceeded 200. Rain spells are given, or periods of more than fourteen consecutive days, every one of which is a rain day, and there is also a summary of droughts. The general rainfall tables afford most valuable information, and, fortunately, the war has caused no break in the publication of the data which have been accumulated now for so many years.

A special article is given on the unprecedented rainfall in the south-west of England on June 28, when 9·56 in. during the twenty-four hours were measured at Bruton, in Somerset. The snowfall of 1917 is dealt with.

The diminution of rainfall with elevation above the ground at Greenwich Observatory is discussed by Mr. W. R. Nash, whose long service at the Royal Observatory adds much to the value of the results. The monthly and yearly values for the several heights carry with them a high degree of exactness. Approximately at 10 ft. above the ground there is a diminution of about 3 per cent., at 22 ft. a diminution of 10 per cent., at 38 ft. a diminution of 20 per cent., and at 50 ft. a diminution of 35 per cent. of the ground rainfall. These results are rather suggestive for aircraft.

C. H.

The Scientists' Reference-Book and Diary, 1919. Pp. 147 + Diary. (Manchester: Jas. Woolley, Sons, and Co., Ltd.) Price 3*s*. 6*d*.

THE physical and chemical constants, together with the scientific and general information contained in the reference-book, will prove of real assistance to the worker in science. The convenient manner in which the data are arranged will make reference easy, and the fact that the book and diary are bound together in a case of a size suitable for the pocket should continue to give the pocket-book a wide popularity.

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.*]

Climograph Charts.

MY attention has been directed to a note in NATURE of October 17, 1918 (p. 132), on the origin of the chart called a climograph, which gives a graphic representation of the climatic conditions of a locality in the course of the year in respect of warmth and moisture. The paragraph states that the method is due to Dr. Griffith Taylor, of the Meteorological Bureau, Melbourne. I think it should be noted that diagrams of a similar character with the dry bulb, instead of the wet bulb, combined with the relative humidity, were described and illustrated by Dr. John Ball, of the Egyptian Survey Department, eight years ago in the November issue of the *Cairo Scientific Journal*, vol. l., No. 4. We discussed the diagrams at the Meteorological Office early in 1911, when the late Mr. W. Marriott, of the Royal Meteorological Society, produced a number of similar diagrams for English stations, some of which were particularly intriguing, because they failed to distinguish, as we thought they might have done, between places which had the reputation of being bracing on one hand, and relaxing on the other.

The subject was further pursued in a paper by Dr. Ball and Mr. J. I. Craig, read at the meeting of the British Association at Portsmouth in 1911. Mr. Craig, in reading the paper, exhibited slides representing on that plan a variety of climates, such as unhealthy climates, continental and marine climates, London, the cotton lands, the monsoon, the influence of altitude, dry health resorts as compared with London, Toronto as compared with Davos, and various climates of the United States. These graphs differ from those afterwards prepared as climographs by Dr. Griffith Taylor in having the dry bulb instead of the wet bulb, and the alteration, for the most part, makes little difference to the general appearance of the diagram, though it alters its position on the sheet.

As a matter of fact, neither form of diagram seems to be completely satisfying as distinguishing between the comfortable, the tolerable, and the unendurable in climate. Some years ago Mr. W. F. Tyler, of the Chinese Customs Service, pointed out that between limits of temperature, say 55° F. and 65° F., nobody minded much what the humidity was; but outside these limits of the "generally comfortable" there was a range of temperatures of the "just tolerable" order for damp air, which soon got to the "unendurable" on the side of higher temperature. Beyond these, again, is a range of temperatures under which life is possible only in dry air. An effective climatic diagram would in some way or other exhibit the relation of the climate to the ranges compatible with comfort, life, and death. NAPIER SHAW.

Meteorological Office, South Kensington, London, S.W.7, January 1.

A University Association.

PROF. ARMSTRONG'S letter in NATURE of January 2 has just come to my notice, and as chairman of the Conference of University Lecturers, to which reference was made in these columns under the "University and Educational Intelligence" of December 12, I hasten to accord my hearty agreement with his timely protest against the advertising of a chair of chemistry at King's College, London, at the "princely salary" of 600*l*. a year.

Prof. Armstrong hopes that the profession will make no response. There is, however, little doubt that there will be a quite substantial competition for the post among the best of our chemical lecturers. The reason is, of course, that 600*l*. does appear to the university lecturer a princely plum worth scrambling for; it means for him at one jump an increase to from two to three times his present salary, and he knows that as the number of such relatively well-paid posts is much smaller than the number of lecturers, it is his duty to his dependents to leave no chance untried.

That I am not drawing an exaggerated picture will be evident from a consideration of the following average salaries of non-professorial teachers, calculated from data which I have before me, derived from fifteen universities and university colleges:—

Service year	Number of lecturers	Average salary £
1–5	119	171
6–10	85	193
11–15	77	253
16–20	30	239
21–25	11	263
26–30	4	297
31–35	3	273

The professorial view of a salary of 600*l*. is another matter. What the gentleman appointed to the chair at King's College will think a few years hence is also another matter.

The preliminary to any effort to maintain a reasonable professorial scale of remuneration by the abstention of lecturers from competing for what are for them really well-paid posts is to ensure the lecturer a reasonable living wage. And this, too, is Prof. Armstrong's solution put in rather different form. Why not call the post a lectureship? A glance at the above table will show that to abstain from competing for a 600*l*. post, simply because it is called a professorship, in, say, one's twelfth year of service, is a risk too grave to be taken.

The Scottish lecturers have been recently granted a graded scale rising to 750*l*. This is in line with the revised scheme of remuneration for the scientific staff of the National Physical Laboratory, as follows:—

	Min. £	Yearly increase £	Max. £
Superintendents	800	50	1000
Principal assistants ...	650	25	750
Senior assistants	500	25	600
Assistants, I.	350	20	450
Assistants, II.	250	20	350
Junior assistants	175	15	235

In regard to abstention, another and very vital difficulty arises. How is a lecturer to know what his colleagues will do? He may by abstaining cut his own throat without achieving any reform. Both professors and lecturers are in a dilemma. What is to be done?

The answer is perfectly clear. We university teachers should have an association which would do for us, or enable us to do for ourselves, what the Medical Association does for the doctors. This is a perfectly practical suggestion. It may be taken as certain that in the course of evolution such an association is destined to come. What is to prevent it from being an accomplished fact within six months from to-day? R. DOUGLAS LAURIE.

University College of Wales, Aberystwyth,
January 9.

Airy and the Figure of the Earth.

I SHOULD be very much obliged if any reader of NATURE would kindly give me an answer to the following question:—

In a note on p. 371 of the second volume of the treatise on "Natural Philosophy," by Thomson and Tait, I read: "Airy has estimated 24 ft. as the greatest deviation of the bounding surface from the true ellipsoid." Where did Airy give the result 24 ft.?

Darwin ("Scientific Papers," vol. iii., p. 78) writes: "Airy further concluded that the earth's surface must be depressed below the level of the true ellipsoid in middle latitudes. He gave no numerical estimate of this depression, but expressed the opinion that it must be very small."

It is curious to remark that Todhunter, in his "History of the Theory of Attraction, etc.," made no mention of the paper by Airy on the figure of the earth printed in the third part of the Philosophical Transactions of the Royal Society for the year 1826, which is the paper alluded to in the above quotation from Darwin. OTTAVIO ZANOTTI BIANCO

(Docent of Geodesy in the R. University of Turin).

Torino (Italy), Via della Rocca 28,
November 28, 1918.

I HAVE carefully examined the curious points raised by Sig. Bianco, and cannot find any satisfactory answer to the questions asked.

Thomson and Tait's footnote, in which it is stated that Airy "estimated 24 ft. as the greatest deviation of the bounding surface from the true ellipsoid," occurs also in the first edition of the "Natural Philosophy." It is true, in a sense, that Airy gave in his published paper no distinct numerical estimate of this deviation. Nevertheless, in his discussion of Sabine's pendulum observations, he compared the coefficients of certain terms with the corresponding values in terms of e and A as given in his theoretical formulæ. The value of A so found (see Phil. Trans., vol. cxvi., p. 366) is 0·000064. In latitude 45° the deviation is $aA\times\frac{1}{2}\times\frac{1}{2}$, and this is 334 ft., and not 24 ft., as Thomson and Tait give it.

The only other possible explanation is that Airy had communicated a later estimate privately to Thomson, for it is quite conceivable that Airy may have made an estimate which he never published. I can find no other publication of his in which this estimate is given or from which it may be derived.

In the days in which Thomson and Tait were writing their book—*i.e.* in the "sixties" of last century—Thomson was much interested in the figure of the earth, and he was almost certain to be in touch with Airy.

Personally, I never thought of questioning the accuracy of the footnote. Sir George Darwin read the proof-sheets of the second edition and wrote a number of sections. He let it pass, although in his own writings he says that Airy gave no estimate. This, however, is not quite correct.

I can throw no further light on it. Possibly a better series of pendulum observations than those given by Sabine might lead to the result 24 ft. But that is rather a wild speculation.

C. G. KNOTT.

Some Temperature Anomalies.

I HAVE often noticed the anomalies of temperature to which Mr. Harries directs attention in NATURE of January 9, and have sometimes been inclined to ascribe the high temperature in the east to air that has come from Spain and Africa instead of from the Atlantic, as in the west. But as the result of observations of temperature in the upper air I have latterly thought that Mr. Harries's suggestion is correct, and that the high temperature is due to a descending current. So far as my recollection goes, the phenomenon occurs when an anticyclone is situated over France or the south-east of England, and not in cyclonic conditions such as have prevailed during the past week.

Whatever the cause may be, the temperatures and pressures of the air from 2000 ft. to 25,000 ft. are most highly correlated; from 10,000 ft. to 20,000 ft. the correlation coefficients between temperatures and pressures at the same height are as high as 0·80 to 0·90, and even at 2000 ft. the temperature is far more dependent upon the pressure at 30,000 ft. than it is upon the direction of the wind. Above 35,000 ft. the correlation is negative. It seems pretty clear that this close connection between temperature and pressure must be due to vertical currents induced by the distribution of pressure; it is too close, and above 30,000 ft. of the wrong sign, to be accounted for by the mere adiabatic compression and expansion without change of height, and it may well be that on some occasions the descending currents reach the surface and produce a high temperature, although in general the temperature at the surface is not much influenced by the pressure. W. H. DINES.

Benson, January 10.

Cyclones.

"J. S. D.," in his interesting article in NATURE for January 2 last, makes the following statement:—"Thus the cyclone was looked upon as a warm column of rising air with spirally inflowing winds at its base; the anticyclone, conversely, contained a cold core of descending air. Now we know that the opposite is in reality the truth; the cyclone has a cold core, the anticyclone a warm one." I think it should be pointed out that this pronouncement is only correct for the troposphere, but not for the stratosphere.

Modern methods of sounding the atmosphere have shown that the Arctic and Antarctic cyclones have warm centres in the stratosphere, and Dines (Met. Office Pub., 210 *b*, p. 50) shows that this is true of travelling cyclones also.

Too much importance has been attached to the temperature distribution in the lower portion of the troposphere. Modern discoveries have merely located the hot core of the cyclone in the stratosphere instead of in the troposphere, leaving the temperature theory still the cause of the cyclonic circulation of the wind and the force that lifts up a cool central column of air from the ground.

I think it will be found that the energy of cyclones can be maintained on the temperature theory with a very slight interchange of air between the stratosphere and troposphere in the case of the polar cyclones, and in the case of travelling cyclones by the bodily rising of the air in the central regions during their comparatively brief life.

R. MOUNTFORD DEELEY.

25 Beaconsfield Villas, Brighton, January 4.

MR. R. M. DEELEY is quite right in pointing out that it is only in the troposphere that depressions are relatively cold and anticyclones warm. It is in this region that the striking contrast appears between the old preconceived theory which postulated a warm core and the results of modern observation. The mechanism by which a cyclonic depression is maintained in being forms one of the great unsolved problems in meteorology. Some years ago the suggestion was put forward by Mr. W. H. Dines that the driving force of the depression was to be looked for in the level at the base of the stratosphere. According to this view, a very slowly descending, and therefore warmed, column of air in the stratosphere is just such an integral part of the whole system as the rising, and therefore cold, column in the troposphere, but neither the one nor the other is to be regarded as the cause of the depression. Mr. Deeley may be right in his view that the warm column in the upper layers is the fundamental cause, but this view is not at present generally accepted.

J. S. D.

The Brussels Natural History Museum.

To many of your readers who appreciate the value of the collections in the Brussels Museum, the following extract from a letter written by Dr. Dollo on January 5 will be welcome news:—"Mais je vous avais écrit également une carte postale illustrée, représentant notre Galerie des Vertébrés vivants et fossiles de la Belgique, pour vous dire que tout était bien ici, que *notre Musée est intact*, qu'il n'y manque absolument rien, et que nous étions saufs!"

A. C. SEWARD.

Downing College Lodge, Cambridge,
January 12.

BORINGS FOR OIL IN THE UNITED KINGDOM.

THERE is no need to labour the importance of liquid fuel in our national economy and existence. The growing needs of our Navy and Air Service, and the difficulties of transport during the war, have driven home the lesson and rendered imperative the demand that we should increase to a maximum the output of liquid fuels in the British Isles. The present production, mainly from the Scotch oil-shales and some of the coal-tar distillates, is very inadequate, and the country has had to depend almost entirely on foreign supplies. Such a state of affairs is obviously deplorable, and if remedies are possible the neglect to apply them would be highly culpable. Two methods of alleviating the situation have been suggested, and both are being tried. The first entails the extensive retorting of British oil-shales and cannels to produce oil by destructive distillation; the second involves the drilling of wells in selected areas in a search for free crude petroleum in commercial quantities. With the first method the present writer is not here concerned; it is the attempt to find oil in the free state which forms the subject of the ensuing remarks.

The generally received opinion, that Nature, so lavish in her gifts of coal and iron to these favoured islands, was unaccountably frugal with petroleum, has not been accepted by all. A small minority has urged, and recently with insistence, that the assumption is based largely on the absence of definite intelligent exploratory drilling—that we are, in fact, in the same position as the United States before the Drake well of 1859, ignorant of the great stores of wealth lying available below the surface.

If this view be sound its importance cannot be over-estimated; if it be only possible it is well worth investigation; if it be absurd the importance of the issue renders it necessary that it should be seriously confuted. It must be admitted that the history of scientific opinion affords numerous instances of truths finally prevailing against the hostility of accepted opinion. It is perhaps not to be wondered at that in consideration of its urgent needs the Government should have resolved to put the matter to the practical test. But it by no means follows that a commercial supply of oil will be forthcoming, in spite of the sanguine dreams and hopes of those who have pronounced favourably on the project. Petroleum is an unusually elusive substance, and the records of its development teem with "wild-cat" schemes, some of them successful, most of them failures, but all of them graced with the blessings of some sober expert. The very term "wild-catting" is a recognised name in oil technology for exploratory drilling of a purely speculative nature based on little or no evidence; the present scheme comes definitely within the limits of the term.

It must be asserted at the outset that the general public report of the whole project has given an unduly optimistic account of the views of men of science on the problem. The measure of its success will be judged, as in any commercial undertaking, by the returns. Nothing short of the promised oil-fields would be an adequate return. The bulk of informed geological opinion —and the problem is essentially geological—is, to say the least, sceptical. It will therefore be well at this stage to sum up the evidence in order to ascertain what justification there is for the position of those numerous geologists who, in spite of, or rather in consequence of, their knowledge of the structure and geological history of the country, have been in the past, and still remain, unconvinced as to the likelihood of the existence of large supplies of oil therein.

Apart from a few exceptional cases, the oil-fields of the world can be divided into two main groups, those in rocks of Tertiary and Upper Cretaceous age, and those of Palæozoic age. The former are situated along the trend of the Tertiary geosynclinals; they are usually affected by folding movements, sometimes intensely folded and thrust, and generally show abundant surface indications of their contained petroleum. A few important exceptions occur, such as the Mexican and Gulf States fields, where there is little folding, and surface evidence of the hydrocarbons is often absent. These exceptions are in their structures more allied to the Palæozoic fields. The latter are largely confined to North America; they range in age from the Ordovician to the Carboniferous; folding is either absent or is of a gentle, open nature, and the presence of surface indications of petroleum is exceptional.

In Britain the Tertiaries would not be seriously considered as a possible source of petroleum in large quantities. Their extent is limited, their structures are in the main synclinal, and they have been riddled by wells in a search for water. Neither do the Mesozoic strata yield indications of a more hopeful character. The claims of Dr. Forbes Leslie of abundance of free oil in the Jurassic strata near the Wash have been negatived by the work of all other investigators. It is to the Carboniferous system of the Palæozoics that most attention has been directed as the possible source of petroleum. The indications of this material are too numerous to mention here in detail. An excellent account of them will be found in W. H. Dalton's paper on "The Oil Prospects of the British Isles,"[1] and a further summary is contained in a recent publication by H.M. Geological Survey on "Lignites, Jets, Kimmeridge Oil-shales, Mineral Oil, Cannel Coals, and Natural Gas."[2] Most of these petroleum occurrences are insignificant and ephemeral; they range over the whole gamut from solid asphalt to natural gas. In a few cases, however, the supply of oil has been sufficient to be exploitable on a small scale, though only for a limited period. Thus at the Riddings Colliery, Derbyshire, a yield of oil averaging about 300 gallons a week was obtained for some years, and was the primary cause of the development of the Scotch oil-shale industry.

Judging by what has been published on the subject, it is to be presumed that the extensive scheme which has been inaugurated is largely based on the selection of suitable areas where Carboniferous rocks with suitable structures either outcrop or will be reached at convenient depths. The initial test near Chesterfield is obviously based on this principle. The sandstones of the Millstone Grit series and the porous horizons of the Upper Carboniferous Limestone will be available porous reservoir rocks, while the Coal Measures and Pendleside Shales will be relied on to constitute the overlying impervious strata which are essential to prevent the oil from escaping. The basis, then, of the project is simple. It rests on the numerous small indications of natural hydrocarbons the majority of which have been located in the Carboniferous strata, and it relies on the location of suitable geological structures for test-wells. Other formations will probably be tested, but presumably the main reliance will be placed on the Carboniferous.

Having now considered the guiding principles of any search for free oil in this country, it remains to discuss the possibilities of success. It will be generally agreed that the *bona-fide* petroleum indications are quite numerous, though they are mainly insignificant. Further, it will be conceded that in many, if not in most, cases they are examples of natural crude petroleum or asphalt, as distinct from the products of destructive distillation from coal seams by local igneous metamorphism, though examples of this action are quite common. Moreover, it will be admitted that there are suitable anticlinal structures for oil concentration, and abundance of porous strata

[1] Journal of the Institution of Petroleum Technologists, vol. iv., No. 13, p. 37, 1917.
[2] Mem. Geol. Survey. Special Reports on the Mineral Resources of Great Britain, vol. vii., part i., p. 41, 1918.

to contain the liquid material. To strengthen the main argument, analogies are drawn by those in favour of the project between the Palæozoic oil-fields of North America and the corresponding strata in Great Britain, and emphasis is laid on the supposed association of coal and oil—an association which is the exception rather than the rule, and is of very doubtful significance. Further support is sought in the curious theory propounded by Mr. E. H. C. Craig that the Scotch shale-fields are essentially an old oil-field in which the petroleum has become inspissated, has combined with the clay, and has produced the valuable seams of shale which form the raw product of the industry.[3]

At first sight this body of evidence appears by no means negligible, and there are numerous oil-fields which have been founded on more slender data. It is only when we examine the negative evidence that a true perspective is obtained and that the reasons for a pessimistic attitude become apparent. To begin with, the numerous evidences of petroleum in Britain are neither surprising nor abnormal; they are merely examples of the general rule that petroleum in small quantities is almost universal, particularly in sedimentary rocks. Britain, with its wealth of strata, representing all phases of marine and terrestrial conditions, would undoubtedly contain examples of such a widespread material. There is a world of difference, however, between a small patch of oil and a large accumulation. One represents the result of a process of organic decomposition which is not uncommon; the other entails this process on a much larger scale, and involves in addition an accompanying or succeeding phase of conditions favouring the concentration and preservation of this material. This association of essential independent conditions on a large scale is necessarily a much less common event.

Secondly, the parallel drawn between the Pennsylvanian and other Palæozoic fields of the United States and the British Carboniferous is not merely misleading; it is untrue. The cases are not parallel; they are opposite. For in all these oil-fields in the older strata the distinctive feature which requires explanation is not the formation of the oil, but its preservation from the dispersive effects of denudation. The outstanding feature of these Palæozoic oil-fields of America is the absence of strong folds and faults; the structures are either terraced, or broad open folds with dips generally below 5°. When the Appalachian oil-fields approach the areas of more pronounced folding the oil disappears. It is not suggested that oil does not occur in strongly folded strata; on the contrary, this is quite common in the Tertiary oil-fields; but it is maintained that such structures are incapable of preserving the elusive fluid in commercial quantities for long geological periods when the rocks are jointed, faulted, and folded, and the subsequent denudation is extensive. The blanketing effect of the overlying formations must be extremely effective to prevent the dispersion of the oil, and in this particular the folded and faulted structures of the British Carboniferous and their extensive dissection render them in no sense comparable with the altogether abnormal structures of the Palæozoic oil-fields of North America.

With the theory that the Scotch shale-fields are relics of an old oil-field the writer does not propose to deal. It accords with neither the geological nor the chemical data, and does not require serious controversy.

That a true estimate of the whole problem may be obtained, it is necessary to consider briefly the primary conditions for the occurrence of oil in commercial quantities. These involve three main factors: the formation of large quantities of the material, its migration into suitable reservoirs of porous rocks, and its preservation in these reservoirs from complete dispersion by volatilisation or by denudation. With reference to the formation of the material, it is now generally admitted that the origin of the oil is primarily organic; further, it may be confidently stated that the balance of evidence strongly supports a marine habitat. Such marine conditions with abundant remains of organic life decomposing under anaerobic conditions have certainly occurred in the geological history of these islands. Neither was there any paucity of suitable reservoir rocks and structures to guide the concentration of the petroleum. It is the preservation of the material from dispersion and loss which presents the whole difficulty. This will be fully appreciated by those conversant with the folded and faulted character of the Carboniferous rocks and the extensive denudation to which they have been subjected since their deposition. This denudation extended over the long terrestrial period of the later Palæozoics and the early Mesozoics, and was followed by a second period of erosion extending from early Tertiary times to the present. This intense dissection of the Carboniferous folds, rifted as they are with important fault systems, has given every opportunity for the oil to effect its escape.

In conclusion, it may be pointed out that in general the widespread Tertiary oil-fields have been largely folded by orogenic movements of Middle Tertiary age. The subsequent erosion, though in the geological sense quite short, has been sufficient in many cases to allow already a natural escape of the hydrocarbons to the surface, and man is busy tapping the remaining resources before Nature has completed the task. The American Palæozoic fields owe their preservation to unique structure and protection from erosion. The British Carboniferous strata, those in which the prospects have been considered to be most favourable, are much more strongly folded and faulted than their equivalents in the American oil-fields, and their dissection is much greater. The whole evidence of the geology, and the cumulative experience of the smallness and ephemeral nature of any oil occurrences which have been noted, agree in indicating that large commercial

[3] "Kerogen and Kerogen Shales." Journal of the Institution of Petroleum Technologists, vol. ii., pp. 238–73, 1916.

underground supplies of petroleum do not exist in this country. Small deposits have been found in the past, and will no doubt be found in the future, but the present search for large commercial supplies is not justified by the scientific evidence, though there is no doubt that the bores will yield useful scientific data. V. C. ILLING.

THE BRITISH DYE INDUSTRY.

THE report, in the *Times* of January 6, of the annual meeting of shareholders in Levinstein's, Ltd., held on December 23, contains one important announcement—namely, that the long-contemplated amalgamation of the company with the Government company known as "British Dyes, Ltd.," is now practically an accomplished fact. The new company is to be called the "British Dyestuffs Corporation, Ltd."

As reported in NATURE of December 5 last, a scheme had been adopted by the President of the Board of Trade in response to a memorandum presented by the Association of Chemical Manufacturers urging the desirability of a more general utilisation of the industrial and scientific resources of the country, and avoidance of overlapping and competition. The White Paper which contains the scheme was summarised in NATURE of November 21 last.

As a result of the amalgamation of the two great companies, an important step has been taken in the direction of presenting a more united front in the great commercial struggle which will in all probability begin so soon as Germany assumes a more settled condition. At the present time the outlook is less formidable for the British colour-maker than it was before the armistice, as the economic position of Germany will continue for some time to be more than doubtful. Labour will undoubtedly command higher wages, raw materials will not be so freely at the disposal of German manufacturers, competition in America and other countries is developing, and there is a widespread reluctance on the part of the Allied nations to resume business relations with the Central Powers severally or collectively.

On the other hand, the works and appliances of the German firms remain substantially undiminished in extent and unimpaired as to organisation, while they still possess a large body of expert chemists and engineers fully acquainted with the details of the business, though doubtless there have been serious losses in the course of the war. It is, however, satisfactory to learn from the address of Lord Armaghdale, the chairman of Levinstein's, that, in his opinion, provided sufficient financial support is forthcoming, this country may be rendered independent of German dyestuffs. On the scientific side, he added, success is certain. There is in this country a larger amount of chemical talent than has hitherto been recognised, and during the war many university professors and others occupied with purely scientific research have given valuable assistance to the colour industry, as well as in other departments of manufacture.

Considering the difficulties to be overcome in the revival of chemical industries in this country at the beginning of the war, and, as compared with Germany, the serious lack of organisation and of scientifically trained assistance, the success so far achieved is encouraging in the highest degree. There is no justification for the gloomy view of the situation sometimes taken, and if the scheme now working under the Board of Trade is not perfect, it is, at any rate, a step in the right direction, and has been accepted by the dye-makers and the dye-users.

The trade and licensing committee referred to in the scheme has now been constituted under Lord Colwyn as chairman. The following are the other members: Mr. Henry Allen, Mr. Milton Sharp, and Mr. Lennox B. Lee, nominated by the Colour Users' Committee; Mr. T. Taylor, representing the paint and varnish manufacturers; Dr. Herbert Levinstein and Mr. J. Turner, nominated jointly by British Dyes, Ltd., and Levinstein's, Ltd.; Mr. W. J. Uglow Woolcock, M.P., nominated by the Association of British Chemical Manufacturers; and Mr. W. H. Dawson, nominated by the President of the Board of Trade. The Commissioner for Dyes, Sir Evan Jones, M.P., will be an *ex officio* member without a vote. Dr. H. Levinstein is the well-known managing director of Levinstein's, Ltd., and he will control the scientific and manufacturing operations of the new corporation resulting from the fusion of British Dyes and Levinstein's. Mr. J. Turner has been a director of British Dyes, Ltd., for several years, and he will be largely influential in the business arrangements of the conjoint firms.

The functions of the committee now constituted will be to determine the colours and intermediates which shall be licensed for import into the United Kingdom after the conclusion of peace, and to advise the Commissioner for Dyes as to the colours and intermediates the manufacture of which in this country should be specially encouraged.

It is satisfactory to find that the Port Ellesmere indigo factory has been in full work for some time, and that land has been secured for considerable extensions of the works in the near future.

THE PRELIMINARY EDUCATION OF MEDICAL STUDENTS.

THE education committee of the General Council of Medical Education and Registration has presented a report on "The Nature of the Recognition to be Extended to the Schools Examinations recently established by the Board of Education in England." It will be remembered that the English Board of Education has established two "schools examinations," to be known respectively as the "first" and "second," or "higher," examination, the former for pupils of about sixteen years of age, and the latter for those a year or two older. The standard of the former is to be such that a "pass with credit" would entitle the candidate to admission to a university, and a slightly lower standard should be accepted for an ordinary pass. The "second examination" would assure that the candidate has, after the stage marked by the "first examination," followed a more specialised course on the lines indicated by the regulations for secondary schools.

Three kinds of certificates are to be issued: (1) The certificate of success in the "second examination" bears the name of the subjects in which the candidate has passed, and is accepted *pro tanto* by the universities in respect of the subjects which they recognise as satisfying their regulations for matriculation, and are likewise accepted by the General Medical Council; (2) that form of certificate in the "first examination" in which the candidate has obtained a "pass with credit" in certain of the subjects bears the names of the subjects, and these will be accepted *pro tanto* by the universities and the General Medical Council; (3) the form of certificate in the "first examination" for candidates who have not passed with credit is termed an "ordinary pass." The names of the subjects actually passed are not detailed, but only the "groups" to which the subjects passed belong.

The last certificate is a general one, and as such is supposed to give evidence of a general education, and no information is given as to the subjects in which the candidate has attained pass marks unless he has attained a "pass with credit" in such subjects; as, however, the General Medical Council requires evidence of proficiency in certain subjects, it will be compelled to call for a "pass with credit" in these subjects. The committee accordingly recommends the council to accept the "first schools examination" of the English Board of Education as sufficient evidence that the holder has fulfilled the educational conditions required of candidates for admission to its "Register of Medical Students," provided that the subjects of English and mathematics have been passed "with credit."

It is hoped that this plan, if adopted, will raise to some extent the standard of the present junior entrance examination. The essence of the new scheme is that it is based on education, and not examination only, for one of the Board's main objects in instituting the new system of examinations was to remove the pressure of external influences from the teaching work of the schools. If the General Medical Council refused to accept this examination in any form, it would in so doing place a serious obstacle in the way of the Board of Education, since many pupils preparing for a career in medicine, while possibly being submitted to the "schools examination" by their schools, would have also to train for some external examination.

THEODORE ROOSEVELT.

THE ex-President of the United States who died in the first week of 1919 was in many ways the most remarkable man I have ever met, and combined with unusual qualities of intellect and co-ordinated development of bodily skill—for was he not a fine shot, a bold equestrian, an untiring marcher, an adept at most games and sports?—a kindness and sweetness of disposition, and a thoughtfulness for the happiness and well-being of all around him, very rare in great men of the world.

He was a field zoologist of the new school, the school which has given us J. G. Millais, Radclyffe Dugmore, Ernest Seton, C. W. Beebe, and a host of young and middle-aged Americans, who have studied wild life with unswerving accuracy, seeking only to set forth the truth in real natural history, and disposing summarily of many a hoary lie and legend about wild life, scorning, moreover, the vagueness of statement and nomenclature which arises from imperfect observation and inadequate study.

Theodore Roosevelt was not only a great naturalist himself, but—what in its ultimate effect was even more important—he set, as President, the fashion in young America for preserving and studying fauna and flora until he had gone far to create a new phase of religion. Under his influence young men whose fathers and grandfathers had only studied the Bible, the sacred writings of the post-exilic Jews and Græco-Syrian Christians, now realised that they had spread before them a far more wonderful Bible, the book of the earth itself. Geology, palæontology, zoology, botany, ethnology, were part of Roosevelt's religion. He may have been a specialist in none of these branches of science, but he saw the divinity pulsating through them, more glowingly apparent than in narrow imaginings of theology.

The man's memory was prodigious. I once spent some ten days—in two separate visits—as his guest at the White House in 1908. At one luncheon party the question of Mayne Reid's novels came up. Roosevelt gave a *précis* of the more remarkable of their plots, of their characters, their defects and strong points. So he could with Dickens, Thackeray, Jane Austen, Nathaniel Hawthorne, and Mark Twain. When I was setting out to study the negro in the New World he gave me from memory an almost complete bibliography of the works discussing the slavery question in the United States, from the books of Anthony Benezet in 1762 to those of Olmsted in 1861. Once, when the then Provost of Oriel called and lunched, and was rather perversely Hellenistic in his lore, Roosevelt, with a twinkle in his eye, turned the subject to the Tatar invasion of Eastern Europe in the thirteenth century, and gave us a really remarkable sketch of its chief incidents and ultimate results.

It would be a great mistake to represent this great man as one who monopolised the conversation in public or in private. On the contrary, he was a rarely good and encouraging listener to anyone who had something to say, and singularly courteous about not interrupting. Indeed, he drew out good conversation in those around him, besides being an exceptionally interesting talker himself.

As a writer on zoology Roosevelt is best known by his "African Game Trails" and "African

Game Animals," but his "Outdoor Pastimes of an American Hunter" (1908) are well worth reading, both for letterpress and illustrations. "Through the Brazilian Wilderness" gives a truthful, though not always exhilarating, description of the Brazilian forest and grassy plains. But there is another side to Theodore Roosevelt, and many an instance of his versatility, in the five volumes of his "Presidential Addresses and State Papers." Probably no head of a State in history has uttered so much sound sense with so much originality of diction and illustration. In Roosevelt we had for the first (and, so far, the only) time a great ruler who was also an adept in the modern sciences, a student and an exponent of the New Bible, a statesman who was extraordinarily well versed in geography—prehistoric, historical, political, physical, and commercial—who was strongly interested in botany, ethnology, zoology, philology, modern history, sociology, and questions of hygiene and the struggle for the supremacy of man over recalcitrant Nature. He gave a great impulse to the research into the causes of yellow fever, and the means of eliminating it from Cuba and Panama. If we only had the luck to acquire a Prime Minister with the learning, the driving force, and the sincerity of Roosevelt, what might not be the after-history of the British Empire, could such a Premier direct its destinies and the education of its governing classes for seven years? But, alas! politics in Britain do not breed Roosevelts.

H. H. JOHNSTON.

NOTES.

WE notice with much pleasure that in the new Government Mr. H. A. L. Fisher will remain the President of the Board of Education and Mr. R. E. Prothero, upon whom a peerage has been conferred, President of the Board of Agriculture. Dr. C. Addison becomes President of the Local Government Board, and is succeeded in what becomes the Ministry of National Service and Reconstruction by Sir Auckland Geddes. Sir Albert Stanley continues President of the Board of Trade. Other appointments are:—Minister of Munitions (to become Minister of Supply), Mr. Andrew Weir, upon whom a peerage has been conferred; Food Controller, Mr. G. H. Roberts; First Commissioner of Works, Sir Alfred Mond. The main changes in the Government, however, are of a political kind, and there is not that breaking away from traditional methods which Mr. Lloyd George may have desired, but found circumstances too strong for him to accomplish. We are glad to note, therefore, that Sir Auckland Geddes, speaking on January 10, stated that "the Prime Minister has decided after long thought—it was undoubtedly reinforced by the finding of Lord Haldane's Committee on the Machinery of Government—that it is absolutely necessary that in the new Government there should be a great organ for research, for investigation, and for the collection of information."

A LONG list of promotions in, and appointments to, the Civil Division of the Order of the British Empire for services in connection with the war was published on January 9. The list includes five Knights Grand Cross of the Order (G.B.E.), six Dames Grand Cross (G.B.E.), forty-nine Knights Commanders (K.B.E.), one hundred and seventy-eight Commanders (C.B.E.), and five hundred and thirty Officers (O.B.E.). We notice the following names of men known in scientific circles:—*K.B.E.:* W. J. Pope, F.R.S., professor of chemistry, University of Cambridge; Aubrey Strahan, F.R.S., director of the Geological Survey of Great Britain; Cecil L. Budd, Non-ferrous Metals Department, Ministry of Munitions; and W. J. Jones, Iron and Steel Production Department, Ministry of Munitions. *C.B.E.:* J. W. Cobb, Livesey professor of coal, gas, and fuel industries, University of Leeds; H. H. Dale, F.R.S., director of pharmacology and chemotherapy under the Medical Research Committee; A. Eichholz, Senior Assistant Medical Officer, Board of Education; J. C. M. Garnett, principal, Municipal College of Technology, Manchester; Lt.-Col. R. J. Harvey-Gibson, professor of botany, University of Liverpool; and P. Chalmers Mitchell, F.R.S., secretary of the Zoological Society of London. *O.B.E.:* J. B. Bailie, professor of philosophy, University of Aberdeen; W. Foord-Kelcey, professor of mathematics and mechanics, Royal Military Academy; and W. E. S. Turner, head of the department of glass technology, University of Sheffield. Numerous medical men are included in the various lists of awards and promotions recently announced, the following being among those mentioned in the *British Medical Journal* for January 11:—*K.C.B.:* Lt.-Gen. T. H. J. C. Goodwin, Director-General, Army Medical Service, and Major-Gen. G. J. H. Evatt. *K.C.M.G.:* Major-Gen. W. W. Pike and Temp. Col. J. Atkins. *K.B.E.:* Col. (temp. Major-Gen.) S. Hickson, Col. H E. B. Bruce-Porter, Col. W. Hale White, Temp. Col. Sir Almroth E. Wright, F.R.S., Temp. hon. Col. J. L. Thomas, Dr. E. N. Burnett, and Dr. G. Archdall Reid. *C.B.:* Temp. Col. A. G. Phear, Temp. Lt.-Col. H. L. Eason, and Capt. and Brevet Major (temp. Col.) R. E. Kelly. *C.M.G.:* Col. H. A. Chisholm, Col. E. J. O'Neill, Temp. Col. (hon. Surg.-Gen.) C. S. Ryan, Lt.-Col. (temp. Col.) S. A. Archer, Lt.-Col. (temp. Col.) E. P. Sewell, Lt.-Col. (acting Col.) H. A. L. Howell, Lt.-Col. C. H. Furnivall, Lt.-Col. F. Marshall, Lt.-Col. C. B. Martin, and Lt.-Col. J. W. West.

THE death of Sir Donald Mackenzie Wallace at the age of seventy-seven removes one of the highest authorities on Russia and the Near East. After several years' residence in Russia, during which he devoted himself to an exhaustive study of the Russian people and Russian problems, Sir Donald Wallace published in 1877 a two-volume work on Russia. This book, which was twice revised by the author, the second time in 1912, still remains one of the standard works on that country. For many years Sir Donald Wallace was special correspondent of the *Times* in Petrograd, Berlin, Constantinople, and elsewhere, being frequently sent on missions to the Balkans and to Egypt. For a time he was private secretary to Lord Dufferin when Viceroy of India. From 1891 to 1899 he was head of the *Times* foreign department, resigning that position to undertake the editorship of the extra volumes of the tenth edition of the Encyclopædia Britannica. For the last few years he lived in retirement, doing a certain amount of work for the *Times*, but devoting himself mainly to study. In addition to his work on Russia, Sir Donald Wallace wrote "Egypt and the Egyptian Question" and "The Web of Empire." The materials for the last-named work were collected by him when he was attached to the suite of King George (then Duke of Cornwall and York) during his tour of the Dominions in 1901.

IN a letter to the *Times* of January 11 Dr. W. J. Fenton, dean of the Charing Cross Hospital Medical School, directs attention to the requirements of medical research. He points out that medical research should not be separated from medical education; that the clinician should be familiar with the work of the laboratory; and that the research worker should not be cut off from the clinical aspects of medical problems. From this it follows that the ideal position for medical research work is at the medical schools associated with the great teaching hospitals, and Dr. Fenton would have the senior student and the newly qualified man undertake some of the more elementary problems of research, not only for the sake of the advancement of knowledge, but also for the invaluable scientific training thereby obtained. Research should demand the whole time of a specially selected body of men, who should be adequately remunerated, and funds should be provided by the State for this and for equipment and assistance. Practical results must not be impatiently demanded, nor should research be exclusively directed towards special objects. It cannot be too strongly emphasised that neither medical research nor medical education can by any means be rendered self-supporting. Any system of grants-in-aid—which may be the best method of State assistance—must be contemplated on a much wider and more generous scale than has been the case hitherto.

INFLUENZA has further decreased in London, and has almost ceased to be epidemic. The Registrar-General's return for the week ending January 4 shows that the deaths only numbered sixty-five, which is fewer than in any week since that ending October 5, 1918. Deaths from influenza for the week ending January 4 were only 5 per cent. of the deaths from all causes, whilst in the weeks ending November 2 and 9 they were 57 per cent. of the total deaths. Sixty-two per cent. of the influenza deaths given in the latest return were between the ages of twenty and sixty-five. The deaths from the epidemic in the ninety-six great towns of England and Wales numbered 441, and were also similarly fewer than in any week since that ending October 5 last. The *Times* of January 10 gives an account of the epidemic in Italy from its correspondent at Rome. "The deputy Signor Monti-Guarnieri has addressed an interrogation to the Government concerning the measures to be taken in view of the recrudescence of the influenza epidemic. The deputy asserts that the epidemic has killed 800,000 people." The *Times* correspondent is of opinion that the estimate is an exaggeration. "This is the third wave of the epidemic. During the first wave the cases were slight, but during the second in October and November they were very severe. A lull came half-way through November, but lately the number of cases has increased again, though the type seems less severe. . . . Everyone will assure you that the deaths from influenza are more numerous than from the war." The correspondent adds: "I hear from one village, which lost sixty-two soldiers in the war, that the deaths there from influenza are nearly 150."

THE representative in the third generation of a great family of botanists, M. Anne Casimir Pyramus De Candolle, died on October 3, 1918, at Geneva, where he was born in 1836, and where the greater part of his life had been spent. Casimir De Candolle was a good botanist, and made valuable additions to the sum of botanical knowledge, though his work was not of such fundamental importance as that of his father, Alphonse, and grandfather, Augustin. He contributed one of the latest volumes (part xvi., 1864–69) to the great systematic work initiated by Augustin P. De Candolle, the "Prodromus Systematis Naturalis Regni Vegetabilis," namely, that dealing with the families Piperaceæ, Juglandeæ, and Myricaceæ, and was associated with Alphonse De Candolle in the issue of the series of monographs (1878–96), "Monographiæ Phanerogamarum," which was to supplement the "Prodromus"; to the first volume (1878) Casimir contributed a monograph of the Meliaceæ. He also wrote numerous taxonomic papers, mainly dealing with the Piperaceæ and Meliaceæ, and though, perhaps, best known as a systematist, he was keenly interested in the morphological and physiological sides of botany. Almost his earliest paper was a study of the morphology and taxonomy of the Juglandeæ, and in 1868 he published a "Théorie de la feuille," in which he interpreted the leaf as a flattened branch; and this was followed at intervals by other papers on leaf-structure and function and on phyllotaxy. Casimir De Candolle had many friends among the older systematists in this country, and workers were always sure of a kindly welcome to the De Candollean herbarium in Geneva. Among his numerous honours he counted the foreign fellowship of our Linnean Society and an honorary doctorate of Aberdeen University.

WE regret to see the report that Sir William Peterson, Principal of McGill University, Montreal, was stricken with paralysis a few days ago while addressing a meeting.

DR. EDGAR T. WHERRY, Bureau of Chemistry, Washington, D.C., has assumed the duties of editor-in-chief of the *American Mineralogist*, in succession to Mr. Wallace Goold Levison, who has retired.

THE second lecture of the series arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, January 22. The chair will be taken at 4.30 by Lord Balfour of Burleigh, and a lecture on "Industrial Reconstruction in Government Departments" will be delivered by his Honour Judge Edward Parry. Applications for tickets should be made to the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4.

THE council of the Geological Society has this year made the following awards:—Wollaston medal, Sir Aubrey Strahan (Director of H.M. Geological Survey); Murchison medal, Miss Gertrude L. Elles (Newnham College, Cambridge); Lyell medal, Dr. W. F. Hume (Director of the Geological Survey of Egypt); Bigsby medal, Sir Douglas Mawson; Wollaston fund, Dr. Alexander Logie Du Toit (Geological Survey of South Africa); Murchison fund, Mrs. Eleanor M. Reid; and Lyell fund, Mr. John Pringle (Geological Survey of England and Wales) and Dr. Stanley Smith (University College, Aberystwyth).

WITH No. 655, published on January 1, the *Geological Magazine* enters, we may hope, on a still wider field of service. In succession to the *Geologist*, which appeared from 1858 to 1864, this journal has been the recognised medium for the publication and discussion of research in a science that appeals specially to workers in our islands. Some of the contributions to its pages, such as Prof. C. Lapworth's papers on "The Secret of the Highlands," have profoundly affected geological interpretation. Work appearing elsewhere has received review and criticism from a staff of specially qualified writers, and the veteran editor, Dr. Henry Woodward, has infused into a large correspondence his unfailing personal charm. After fifty-five years of devotion to the magazine, he has obtained the help of Mr. R. H. Rastall as sub-editor, and the choice is a guarantee that the literary character of the journal will be maintained. The two most recent numbers may be taken as types of the importance of the *Geological Magazine* in times when it is at length realised that our national progress depends on scientific method and observation. Dr. Prior, for instance, reviews "The Progress of Mineralogy from 1864 to 1918"; the proposed Mines Department for the United Kingdom is discussed; and Mr. Wilcockson gives the best account of "Coal in Spitsbergen" with which we are acquainted. Mr. R. D. Oldham deals with the difficult question of the constitution of the earth's interior, and the palæontological papers, always a strong feature, include one by Dr. Andrews on "Fossil Mammals from Salonica and Imbros," discovered by officers of our Army in moments of relaxation. The *Geological Magazine* is published monthly by Messrs. Dulau and Co., 37 Soho Square, London, at 24*s*. per annum post free. It should find a place in all libraries where British science is to be represented adequately.

THE new map of the Western front issued by Messrs. W. and A. K. Johnston shows the main lines of the retreat and advance of the Allied armies from 1914 to 1918. The map is on a small scale (1 in. to 18 miles), and no relief is shown, but the lines held at different periods during the war are clearly shown in colour. The German territory occupied by the Allies under the terms of the armistice is shaded red, and a deeper tint shows the neutral zone on the right bank of the Rhine. The map, which is published at 1*s*., forms a useful addition to the firm's series of war-maps.

IN the settlement of the complex problems arising from the break-up of the Dual Monarchy, the question of the distribution of the nationalities in Hungary will be of chief importance. Four articles on this subject by Mr. B. C. Wallis have recently appeared in the *Geographical Review* (vol. vi., Nos. 2, 3, 4, and 5). The papers deal respectively with the Rumanians in Hungary, the Slavs of Northern Hungary, the Slavs of Southern Hungary, and the Magyars and Germans in Central Hungary. Three coloured maps accompany each article, showing relief, density of population, and distribution of nationalities respectively. They fit together to form a complete map of Hungary. The population maps are constructed on the contour method, which the author rightly claims gives gradational representation and avoids the abrupt changes characteristic of most maps of this land. Mr. Wallis has been at great pains to unearth from census statistics a great deal of useful information, the text of the articles containing important facts relating to the social and educational state of the people. The work forms a valuable basis for discussions which will shortly be exercising European statesmen.

IN a paper read before the Royal Society of Arts on December 11, Major-Gen. Sir Frederick Smith described the work of the British Army Veterinary Corps at the fronts. Some 1300 officers, 27,000 men, and 6000 coloured men were employed as a corps in the various theatres of war. Every division possessed a mobile veterinary section for immediate service in the field. Thence the wounded and sick animals were forwarded to a veterinary evacuating station, where a more thorough examination was possible and the diagnosis was checked. Two or three times a week the sick were sent on to the base, where they were placed in a reception hospital, whence they were distributed to a general hospital, mange hospital, convalescent depôt, etc., as the case might be. Some 1,317,000 patients passed through the various hospitals during the war (Journ. Roy. Soc. of Arts, December 27, 1918, p. 80).

THE views of Dr. Edridge Green on colour vision are well known, and considerable interest attaches to his application of them to various problems connected with the subjects of protective and warning coloration in birds and insects. In two recent articles (*Science Progress*, July and October, 1918) Mr. Mottram and Dr. Edridge Green have published a careful study of the distribution of colour in five sub-families of Indian diurnal Lepidoptera and two families of birds (the Nectariniidæ and Loriidæ). On the authors' view that the colour-perception of many enemies of insects has not advanced beyond a stage in which green and brown are indistinguishable, the brown and green dimorphism seen in certain groups (as in the larvæ of *Amphidasis betularia*) would be accounted for, the two colours being equally inconspicuous against either kind of background. To such a colour-perception yellow would also be inconspicuous. It is pointed out that complemental colours placed side by side are inconspicuous at long range, but very conspicuous when within their blending distance; hence many "warning" colours are only adapted for use at close quarters. Stress is laid upon what the authors call the "conjuring method" of protection, *i.e.* the sudden disappearance of a bright colour and its replacement by an inconspicuous or deceptive aspect, as in Kallima pursued by an enemy. As a result of a statistical computation, the interesting conclusion is reached that sexual differences from the point of view of colour-vision can be entirely accounted for on the basis of a difference in visibility.

MR. J. WILFRID JACKSON describes the Brachiopoda collected by the British Antarctic (*Terra Nova*) Expedition (*Zool.*, vol. ii., pp. 177–202, 1 plate, 1918) in the New Zealand area and in the Ross Sea. The examples from the latter have enabled the author to make a detailed study of an Antarctic species previously ascribed to the genus Rhynchonella, but for which a new genus, Compsothyris, is formed. No new species has been added to the list of those known to occur in the Antarctic, but our knowledge of the geographical range of those recorded, belonging to the genera Compsothyris, Liothyrella, and Magellania, has been materially extended.

M. E. ROUBAUD discusses (*Rev. gén. des Sci.*, November 15, 1918) the relations between man and mosquitoes with reference to the danger from malaria in France. Anopheles bred from larvæ taken near Paris, fed on cases of benign tertian or of malignant malaria, and kept, some at room-temperature and others at 25° C., were found on dissection to have the developmental forms of the parasite on the stomach or sporozoites in the salivary glands. Isolated cases of malaria and some small epidemics have occurred in France during the last two years, and M. Roubaud states that in regard to the majority of these—chiefly benign tertian, but five were malignant—it has been established that the foci were cases of malaria of colonial or Oriental origin. These facts prove that Anopheles in France, when in contact with malaria-carriers, can become infected, and can transmit the organism. The danger is, however, less in practice than would appear *a priori*, for, in spite of the introduction on a large scale of malaria-carriers, the number of new cases in France since the outbreak of the war has been relatively small—about 250—and this is due, in M. Roubaud's opinion, not to the diminution in the number of Anopheles, but to the relative isolation of man from Anopheles, which has been brought about by improved conditions of living. The ideal conditions —isolated groups of people living in shelters on the ground in sparsely inhabited, humid, and wooded areas—necessary to make the relations between man and Anopheles sufficiently intimate and continuous to bring about endemic malaria are in France found only exceptionally where man has retained or resumed a primitive mode of life. M. Roubaud concludes that human progress has brought about a suspension of the previously intimate relations between man and Anopheles, and, consequently, the disappearance of the old foci of malaria.

"A WHITECHAPEL Botanical Garden" is the subject of an interesting note by Mr. W. Roberts in the *Gardeners' Chronicle* of December 21, 1918. The writer has acquired a sale catalogue of a "Collection of plants, shrubs, and fruit-trees; consisting chiefly of valuable exotics, beautiful flowers, and a large number of pines in full fruit and succession; of Mr. William Bennett, corn factor and biscuit baker, deceased," to be sold on March 27, 1766, at the garden in Whitechapel Fields. Nothing further is known of William Bennett, but the catalogue indicates that the garden was of a very special and interesting nature, and the approximately accurate botanical character of the nomenclature proves that Bennett's interest was as much botanical as horticultural. His garden contained several specimens of many plants which were rare in this country a century and a half ago, Many of the plants in the list were of comparatively recent introduction, and several appear to have been grown by Bennett many years earlier than the dates recorded for their introduction into Great Britain; Mr. Roberts instances *Selago spuria*, *Pisonia aculeata*, and *Ruellia ciliata*. The exotics are from widely different regions, tropical and otherwise. According to a contemporary map, Whitechapel Fields occupied a broad space on the south side of Whitechapel Road and Mile End, extending east from the present-day London Hospital down nearly to Ratcliff Highway. Adjoining them were the Mulberry Gardens.

THE recently published issue of the Imperial Institute Bulletin (No. 2, 1918) contains useful articles on South African grasses for paper-making, Ceylon tobacco, and cotton in Egypt. Of the South African grasses, *Andropogon hirtiflorus* is said to be quite suitable for the manufacture of paper pulp on a commercial scale, but the other grasses appear to be of value mainly in South Africa. Tobacco in Ceylon has been taken up with the view of obtaining an improved type of pipe tobacco, and judging from the report, the trials appear to have met with success. With regard to cotton, Mr. G. C. Dudgeon, consulting agriculturist to the Ministry of Agriculture, Egypt, discusses the question of the maintenance of the quality of Egyptian cotton. It is well known that if any serious deterioration in the quality of Egyptian cotton occurred, it would inflict great damage on the British fine cotton spinning industry. Mr. Dudgeon points out that Egyptian cotton has in recent years consisted of a number of varieties of cotton, each an improvement on its predecessor, and each in its turn destined to deterioration through crossing in the fields with inferior kinds. The quality of the cotton produced has, however, on the whole improved, but unless some system of protecting improved kinds is introduced there can be no guarantee that the present good quality of the output can be maintained. The principal action required is the isolation and issue of seed of the best kinds in a fairly pure state, and the steps necessary to this end can be taken by Government only with the consent and active support of the Egyptian producers.

THE Bureau of Standards of the United States has issued an emergency edition of its Circular No. 27 on the properties and testing of optical instruments, pending a more complete revision of the circular in a few months. It contains a large amount of information on the design and the principal causes of imperfections of optical instruments not easily accessible to the general public owing to its being scattered widely in optical text-books and periodicals, and to the mathematical form in which it usually appears. The circular deals in succession with definition and resolving power, magnification, brightness of image, and field of view of instruments of observation, with the various aberrations and distortions of instruments for reproduction, and with instruments for measurement. Many of the simpler tests for such instruments are described, so that it is quite possible for the owner of an instrument to test it himself, but in case more complete tests are required the Bureau undertakes them at fees from a dollar upwards. No charge is made for tests undertaken in the public service or in aid of researches for the development of the optical instrument industries of the United States.

IN the September issue of the Science Reports of the University of Sendai Prof. K. Honda and Mr. J. Okubo give a new theory of magnetism which agrees more closely with the observed facts of para- and diamagnetism than any previous theory. According to it, the molecular magnets rotate about axes not in general coincident with their magnetic axes. The component of the magnetic moment of a molecule along the axis of rotation the authors call the axial, and that at right angles the transverse, component. When a magnetic field acts on the molecule, precession and nutation take place owing to the axial component of the magnetic moment. The nutation is damped out by thermal impacts amongst the molecules, but the precession continues at an angle which implies increase of magnetic moment in the direction of the field, and the effect is paramagnetic. The transverse component of the moment causes the rotation of the molecule to be faster when that component is in the same direction as the field, and to be slower when in the opposite direction. The time mean of the effect is therefore in the opposite direction to the field —that is, it is diamagnetic. The preponderance of one effect over the other determines the para- or diamagnetic character of the material.

BAUMÉ's hydrometers, especially the one for liquids heavier than water, are largely used in various industries. As is well known, much confusion has arisen in the conversion of the hydrometer readings into terms of specific gravity. This is due to the fact that in graduating the early instruments the temperature of the water used was not given precisely, nor was the density of the "heavier" liquid (a solution of salt) correctly obtained. Hence several different conversion tables have been employed, showing, of course, different specific gravities for the same hydrometer reading. The formula for conversion is: Degrees Baumé $=m-m''$sp. grav., where m is the constant or modulus on which the scale is based, and the uncertainty has been as to the true value of m. The Bureau of Standards, Washington, holds that the value should be 145, and this is now adopted generally in the United States except in the sugar industry. A new conversion table has recently been issued by the Bureau, based on the value mentioned and on the specific gravity determinations of F. Plato, which are regarded as the most accurate. The temperature adopted is 20° C. These features, it is considered, should especially commend the new tables for sugar work. A copy can be obtained free on application to the Bureau (Technologic Paper No. 115).

A REVIEW in NATURE of January 2 of Prof. Cohen's "Organic Chemistry for Advanced Students" contains the statement, in reference to the portion dealing with chlorophyll: "Curiously enough, no mention is made in the list of references to Willstätter and Stoll's book on this subject." This statement applies to the *list* of references on p. 183 (part iii.), but is ambiguous in so far as it suggests that the book is not mentioned elsewhere in the text. The inference is, of course, incorrect, since the book in question receives full mention on p. 172. It is in order to remove any misunderstanding that we are glad to insert this note.

WE have received from Messrs. Watson and Sons (Electro-Medical), Ltd., a pamphlet on radiography and photography. It includes a price-list, but is chiefly an essay on the practice of radiography, and gives just those details that the practitioner wants to know regarding the choice and use of apparatus, the treatment of the plates, and the printing from them. It is a pity that new names should be introduced without a clear statement as to what they signify. We know what amidol, metol, hydroquinone, etc., are, but what is "sutol"?

Messrs. Longmans and Co. have nearly ready "The Quantitative Method in Biology," by Prof. J. MacLeod, of the University of Ghent. *Messrs. Gauthier-Villars* (Paris) have in the press vol. ii. of R. de Forcrand's "Cours de Chimie" (Chimie organique, Chimie analytique), and vol. i. of "Œuvres de Henri Poincaré," 4 vols., vol. ii. of which appeared in 1916.

OUR ASTRONOMICAL COLUMN.

THE ORIGIN OF NEW STARS.—In an article which appears in the *Revue Générale des Sciences* (November 30, 1918) Dr. J. Bosler, of the Meudon Observatory, gives an able review of the general phenomena of new stars, and discusses the theories which have been put forward to account for them. The suddenness of the apparition of a nova is considered to be against any explanation based upon radio-activity, and it seems difficult to escape the belief that collisions are in some way concerned in the outburst. The brief duration of novæ, and the relative frequency of their occurrence, appear to be opposed to the direct collision of two dark stars as a probable cause, and Dr. Bosler favours Seeliger's view that a nova is produced by the passage of a dark or faint star through an obscure nebulous cloud. The heating effects would then be merely superficial, as in the case of a meteor in the earth's atmosphere, and a reasonable explanation of the spectroscopic changes can be given. The mutual relations between novæ in their later phases and the Wolf-Rayet stars and planetary nebulæ lead Dr. Bosler to the conclusion that these bodies are merely the vestiges of ancient novæ, and have no place in the ordinary evolutionary sequence.

THE FAYETTE COUNTY METEORITES.—A further investigation of three meteoric stones found in Fayette County, Texas, in 1900, has been made by Mr. G. P. Merrill (Proc. U.S. National Museum, vol. liv., p. 557). Hitherto these stones have been supposed to be a part of the Fayette County (Bluff) stone found in 1878, but it now appears that the two finds are to be regarded as belonging to distinct falls. The most striking difference lies in the physical condition of the prevailing silicates, olivine and enstatite, which are cloudy in the stone of 1878 and clear in that of 1900. Calcium phosphate is present in both, but in the later find lacks the gas cavities which are so conspicuous in the other. There are numerous other points of difference, and the greater weathering of the 1900 stones probably indicates that they belong to an earlier fall. The name Fayette County, Cedar, is suggested for the stones found in 1900.

ECLIPSES AND TRANSITS OF JAPETUS.—The orbit of Japetus, Saturn's eighth satellite, is at present seen edgewise, and eclipses and transits are observable. On January 19d. 14·24h. G.M.T. the shadow of Japetus enters Saturn's disc, passing off below our horizon at 23·09h. On February 27d. 11·62h. Japetus is occulted by Saturn; it remains invisible until 28d. 4·24h., when it emerges from the shadow of the ball to enter the shadow of the inner bright ring at 4·83h. It passes the space corresponding with the Cassini division at 7·19h., emerging from the shadow of the outer ring at 8·49h. It will be remembered that in 1889 Prof. Barnard made a series of observations of its brightness while in the shadow of the crape ring, which gave information about its transparency. Such observations will only be possible in longitudes considerably east of Greenwich, but the passage through the Cassini space and the final emergence are observable here.

Another transit of the shadow across Saturn's disc will occur on April 9, beginning at midnight. The eclipse of May 18 is not observable nearer than western America.

THE SUGAR INDUSTRY IN INDIA AND JAVA.

WITH an area under sugar-cane about one-seventh of that devoted to this crop in India, Java has an annual production of cane-sugar not greatly inferior to that of India, and is able, after meeting its own requirements, to export large quantities, for which India is one of the chief markets. In Java the cultivation of sugar-cane is conducted on the most modern lines, and the manufacture of cane-sugar is carried on in central factories, where the processes are chemically controlled at every stage.

In India the cultivation is in the hands of natives, as is also the preparation of the sugar, and both sides of the industry are conducted in somewhat primitive fashion. The Indian industry has not been left entirely to itself by the Government, and a certain amount of experimental work on the improvement of canes and in the introduction of better methods of preparing sugar has been carried on for some time by the Imperial Department of Agriculture in India and the Indian Provincial Departments closely interested, but so far this work appears to have had but little effect either in increasing the Indian production or in stemming the rising tide of imports. Thus Messrs. Hulme and Sanghi, in a note submitted to the tenth meeting of the Board of Agriculture held at Poona in December, 1917, say that "the rapid increase in the imports of sugar before the war caused some anxiety to those in authority, and steps were taken with the view of improving the sugar industry in India" (Bulletin No. 82, Agricultural Research Institute, Pusa).

One of these steps was the erection of a small experimental factory in 1914–15 at the Government farm at Nawabganj, in the Bareilly district of the United Provinces; the authors of the note referred to are in charge of this small factory, and in the note they give some results of their first two years' work. Sugar-cane is grown as an experimental crop at the farm, and the varieties in cultivation have all been analysed and their milling properties tested at the factory. So far the factory has experienced considerable difficulty in carrying out its programme of work. In 1915–16 the machinery was not complete in time for full working, and there was also a difficulty in getting sufficient cane. In 1916–17 the sugar-cane crop in the district was a failure, and only a small supply of inferior sugar-cane was available for working.

The note, in addition to giving a *résumé* of the work done, describes the native methods of making "gur" and sugar, and includes an illustrated description of the plant in the experimental mill.

The following figures quoted by the authors illustrate clearly how much remains to be done to put the Indian sugar industry on a basis which will enable it to compete with Java. The figures are maunds of sugar produced per acre:—Java (modern methods), 110; Bareilly district (modern methods), 64; Bareilly district (native methods), $7\frac{1}{2}$. In view of these figures it is little wonder that, in spite of a 10 per cent. import duty and the payment of freight, railway, handling, warehousing, and other charges, Java can sell sugar in the interior of India against the locally produced article.

THE FLORA OF MACEDONIA.

THE Kew Bulletin (December, 1918) contains an account of the flora of Macedonia by Mr. W. B. Turrill, based on collections made by himself and a few other men engaged with the British Salonika forces. The collections were made mainly in the Struma plain, on the "Lembert Hills," about 8 to 10 km. north of Salonika, and the Krusa Balkan, and represent the flora of the hills (which nowhere reach more than 1000 m.), the foothills, the nullahs, and the plains. The most striking plant of the hill-slopes is the Kermes oak (*Quercus coccifera*), a shrub from 2 ft. to 6 ft. in height, with very stiff, prickly leaves, the host of the crimson-dye yielding "Kermes" insect, which constitutes a distinct formation related to the "maquis" of the Mediterranean area. The nullahs are of two types: those worn out of the solid rocks of the hills, and those cut out of the diluvium of the plains by streams and storms. They have generally very steep sides, which serve as a protection from the sun for at least part of the day, and, as they retain considerable moisture, are able to maintain a flourishing vegetation through the hot summer. When water permanently runs through the nullah a marsh flora may be found on the streamsides, including our British *Lythrum salicaria*, with *Cyperus longus*, and species of Juncus, Carex, Scirpus, Eleocharis, and others. Much of the ground of the plains is, or has been, under cultivation, and at the present time the weed flora is luxuriantly developed; the Struma plain in spring was brilliant with fields of scarlet poppies, pink Silenes, yellow Hypecoum, and a blue lupin.

The parts traversed were generally poor in tree-growth, and forestry is non-existent. The "Lembert Hills" are bare except for the shrubby Quercus formation and low herbage. Inland, trees occur, but nearly always singly or in small groups, seldom worthy of the name of woods. *Quercus conferta* is the commonest tree in many districts, and also occurs as a nullah shrub. In the Struma plain elm-trees reach a good size, and isolated planes are well developed in various localities.

The climate is typically Mediterranean in the long, hot, dry summer, but differs from the climates of most Mediterranean countries in having colder and wetter spells in winter. The autumn rains in October revive the parched vegetation and cause a short period of flowering in autumn before the cold winds and snow of winter.

The author records 625 species and varieties of flowering plants and ferns, representing probably about a quarter of the vascular plants. The flora is predominantly Mediterranean, and is most closely related to the Grecian flora; about one-sixth of the species are common to Macedonia and Greece, but do not extend northwards into Bulgaria. The northern element is, however, distinctly marked, since thirty-eight plants are recorded which occur in Macedonia and Bulgaria, but not in Greece.

One new species is described, a pink-flowered Silene from the Struma plain.

THE MATHEMATICAL ASSOCIATION.

THE annual meeting of the Mathematical Association was held in the London Day Training College, Southampton Row, on January 1 and 2. At the "Advanced Section" of the meeting Dr. S. Brodetsky read a valuable paper on "The Graphical Treatment of Differential Equations." He briefly described the manner in which he was led to take up this subject by being confronted with "insoluble" differential equations while researching on the stability of motion in connection with aeroplane theory. The plan he devised was to sketch first of all on squared paper the curves $dy/dx=0$ and $d^2y/dx^2=0$, thereby obtaining those regions in which the curves satisfying $\phi(x, y, dy/dx)=0$ have positive and negative curvature. Thereafter, by solving directly for dy/dx in terms of x and y, he is able to sketch the curves of the system defined by the given differential equation $\phi(x, y, dy/dx)=0$ as a series of short arcs.

At the "General Section" Dr. W. P. Milne dealt with "The Work of the Mathematical Association in Assisting the Application of Mathematics to Industry." He pointed out that up to now the Mathematical Association had confined itself almost entirely to the work done in the secondary schools, and he said that in the work of industrial reconstruction the association had a wide and clamant field of potential mathematical activity in the departments of engineering, mining, agriculture, commerce, etc. All these spheres of labour are making a great and ever-increasing use of mathematical processes, and it seemed fitting that the association should lend a helping hand in drawing up the appropriate mathematical syllabuses on the most modern lines. It was also informally suggested that, in addition to the London meeting at Christmas-time, a peripatetic meeting should be held in the summer-time at different places in the provinces, so as to study on the spot industrial mathematics in its various forms. Upon a show of hands being taken, it was found that the meeting cordially approved of this informal suggestion. It was also announced that the association had arranged for a series of reports by expert committees on the mathematics of the various pivotal industries, and that these would be made public in due course.

The presidential address by Prof. T. P. Nunn on "Astronomy as a School Subject" was listened to with the greatest attention and appreciation. Prof. Nunn pointed out how desirable it was that modern educated men should know something of the world in which they lived, and said that from time immemorial the movements of the earth and the celestial bodies had excited the interest and admiration of men. He exhibited models of celestial cylinders, spheres, and cubes, all of which could be made with the simplest apparatus, and from which most accurate results could be obtained by schoolboys themselves. Many schoolmasters gave their experiences of teaching astronomy, particularly in Stonyhurst and Bootham School. Prof. Nunn's lecture, which was a departure from the usual presidential address, was an unqualified success. The Astronomer Royal, in the course of the discussion, testified to his appreciation of Prof. Nunn's presentation of the subject.

A paper on "The Teaching of Geometry to First-year Pupils" was introduced by Mr. Basil A. Howard. There was a vigorous discussion, from which it was abundantly evident that teachers do not even yet regard the teaching of elementary geometry as in a satisfactory condition. It seems likely that a cleavage in the near future will be established between "practical experimental geometry" and "theoretical geometry," as the attempt to mix up these two aspects of the subject throughout the school course has not led to the best results, they being neither coincident nor contradictory, but distinct and complementary.

BIOLOGY OF A LIFE-TABLE.

AT a meeting of the Royal Statistical Society on December 17 a paper was read by Dr. J. Brownlee entitled "Notes on the Biology of a Life-Table." Dr. Brownlee pointed out that a life-table contained a record of the natural history of the life-processes of man from birth to death. As man must be looked upon in the light of a physico-chemical engine with the power of working for a certain time, it should be possible to obtain from the different life-tables some indication of the rate at which the engine works and the manner in which the power of working is altered by different environments. That some law exists is shown by the relationship between environment and ill-health advanced by Dr. Farr forty years ago. He established a relationship for the decade 1861–70 that $D = c\delta^p$, where D is the death-rate, δ the number of persons living per sq. m., and c and p are constants. Unfortunately, Dr. Farr could only use crude death-rates, and his law was not found to apply in the subsequent decades. Now, however, it is possible to use life-table death-rates.

It is found, when the different areas in the country are arranged in groups according to their different death-rates, the groups being so large that the effects of different local conditions are averaged out, that the death-rate increases directly as the tenth root of the density of the population as measured by the number of persons on each square mile. The equations for the three decades for which statistics exist are as follows:—

1861–70	... ...	$D = 12{\cdot}42\delta^{\cdot 10018}$
1881–90	... ...	$D = 11{\cdot}45\delta^{\cdot 09850}$
1891–1900	... ...	$D = 10{\cdot}82\delta^{\cdot 10179}$

It follows from this that there must be some definite law underlying the life-processes, and that between the different life-tables close relationships should exist. In an endeavour to find these relationships Dr. Brownlee had made various experiments. In the first instance it was found that if a suitable upper limit to life were assumed, the expectations of life at all ages between ten years and seventy-five years, and the differences of the upper limit of life and the actual age when plotted on double logarithmic paper, lay on a straight line. This gives a relationship $E_x = a(C-x)^n$, where C is the upper limit of life, E the expectation at age x, and a and n are constants. It is further found that n, C, and $\log a$ used as co-ordinates are collinear. The limited range through which the formula could be applied, however, and the fact that the upper limit of life was in most tables quite ridiculously low suggested a search for a better expression. He found on trial that the formula[1] which represents the reaction between a substance and a ferment, when the reaction is such that combination takes place between the substance and the ferment, followed by dissociation as the alteration of the substance proceeds, gave an adequate graduation. Taking the amount of the original substance to be represented by the expectation of life, the relationship between age and expectation is thus given in the following form:—

$$e^{c'x} = \frac{e^{a-nE}}{E}.$$

When this formula is used, c and a are collinear for all life-tables, and c' and n are collinear for each definite epoch, the epochs investigated being the decades 1861–70, 1881–90, 1891–1900, and the three years 1910–12. Further, it is found that all the latter lines are parallel. The constant direction of these may be assumed to be associated with the fact that the exponential relation of the death-rate to the density given by Farr's law is constant. The changing position of the line may also be associated with the change in the multiplying factor, which, as has been seen, has been continuously decreasing. A theoretical drawback to using the formula as given above is that it assumes that the expectation of life is an adequate measure of vitality. This assumption implies that each year of life is of equal value, and therefore equates a year of life lived between twenty and twenty-one with a year of life lived between seventy and seventy-one, though the rate of action of life-processes must be very much greater in the former case than in the latter. This difficulty, however, can be got over when it is noted that the same formula graduates, not only the expectation of life, but also the life insurance premiums, so that it may be taken that any simple law of decay expressible by a geometrical progression acting as life goes on may be included in the argument.

Dr. Brownlee thought that the relationships first given by Dr. Farr, and now found to apply for forty years in England and Wales, as also the relationship between the constants in the formula used for graduating the expectations in the life-tables, showed that the response of the human engine to different conditions was not arbitrary, but governed by very special laws.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The faculties of science and medicine have lately received important benefactions, which will enhance the resources of the University for instruction and research. Messrs. W. G. Gardiner and F. C. Gardiner, shipowners in Glasgow, have made a gift of 60,000*l*. to the University for the foundation of three professorships, at a stipend of 1000*l*. a year each, in bacteriology, in organic chemistry, and in physiological chemistry. The "Gardiner" chairs will be associated with the existing departments of pathology, chemistry, and physiology respectively, in which the several subjects have been represented by endowed lectureships.

The Right Hon. Sir Joseph P. Maclay, Bart., has provided for five years a lectureship for clinical and practical instruction in tuberculosis at the Bridge of Weir Sanatoria. The instruction will be open to medical practitioners and students. Dr. James Crocket, D.P.H., has been appointed the first lecturer.

A professor in the faculty of medicine has founded an "Arbroath" bursary of 40*l*. a year for medical

[1] Mellor, "Chemical Statics and Dynamics," p. 376.

students entering the third year of the curriculum who have given promise of distinction in the first and second professional examinations.

The same professor has also established a prize of about 50*l*., to be awarded every three years, for an essay of distinction (worthy to be published) on some subject relating to the history of medicine. Candidates must be graduates in medicine of the University of Glasgow.

Intimation has also been given of substantial gifts for the foundation of lectureships in diseases of infants and children in connection with the Royal Hospital for Sick Children on Yorkhill, adjoining the University, which was opened by his Majesty the King in July, 1914.

The number of students attending the classes in science and medicine has increased so greatly that, in order to provide accommodation for men released from war service, who have the first claim on the University, it has been intimated that admission to the first-year classes at the beginning of the summer session in April cannot be guaranteed to freshmen not already matriculated.

MRS. ALICE JACKSON has bequeathed 1000*l*. to the University of Sheffield for the Arthur Jackson chair of anatomy.

THE examination for the 1919 scholarship of the North-East Coast Institution of Engineers and Shipbuilders (Newcastle-upon-Tyne) will be held in September next, and copies of the regulations and other particulars may be had on application to the secretary of the institution, Bolbec Hall, Newcastle-upon-Tyne. The scholarship is of the annual value of 50*l*., and tenable for two years.

THE Bureau of Education (Department of the Interior) of the United States, with a view to a comprehensive campaign for the support of the schools and for the maintenance upon them, has arranged since July last to issue bi-monthly a journal entitled *School Life*. The second number contains a letter from the President, in the course of which he says: "That there should be no falling-off in attendance in elementary schools, high schools, or colleges is a matter of the very greatest importance affecting both our strength in war and our national efficiency when the war is over." "After the war," he goes on to say, "there will be urgent need, not only for trained leadership in all lines of industrial, commercial, social, and civic life, but for a very high average of intelligence and preparation on the part of all the people"; and he urges "the people to continue to give generous support to their schools of all grades, and that the schools adjust themselves as wisely as possible to the new conditions, to the end that no boy or girl shall have less opportunity for education because of the war, and that the nation may be strengthened, as it can only be, through the right education of all its people." These are wise and weighty words such as may be expected from President Wilson in this supreme hour of his country's history, and indicate the faith which the nation firmly holds in the place and value of education as the bedrock of its progress towards the realisation of its ideals. "Germany," says the U.S. Commissioner for Education, "has made herself a composite, compact, purposeful nation by methods of education, as well as by authority. We can make ourselves a compact, purposeful nation and impose no authority other than the compelling influence of affection, sympathy, understanding, and education." The journal is full of interesting matter, both domestic and foreign, dealing with various aspects of education. It is mailed free to all administrative officials throughout the States, and furnished to the schools, single or in quantities, at 50 cents per annum. Free libraries in this country would be well advised to supply their reading-rooms with copies.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 22, 1918.—Prof. C. H. Lees, president, in the chair.—A. **Campbell**: (1) The linguistic nomenclature of scientific writers. The note insists on the importance of clear and consistent nomenclature and the avoidance of foreign plural forms, such as *media, genera, radiivectores*, etc. The term *pulsatance* is suggested as a suitable name for $2\pi\times$frequency. (2) Low-frequency microphone hummers. The note describes the conditions of mechanical loading, capacitance, and position which the author has found give successful working at low frequencies. (3) A simple tuning-fork generator for sine-wave alternating currents. The arrangement consists of an electrically maintained tuning-fork, to one prong of which is attached a small thin coil with its axis perpendicular to the direction of motion of the prong. As the fork vibrates the coil oscillates in the field of a fixed horseshoe magnet, and an approximately sinusoidal E.M.F. is set up in the coil. The frequency with the apparatus shown was 10∞ per second. (4) A method of comparing tuning-forks of low frequency and of determining their damping decrements. The method consists in putting the windings of the maintaining magnets in series with each other and with a sensitive vibration galvanometer. The beats are clearly shown by the pulsations of the band of light on the scale.

Royal Microscopical Society, December 18, 1918.—Mr. J. E. Barnard, president, in the chair.—Lt.-Col. Aldo **Castellani**: Tropical diseases in the Balkanic war zone. (1) Tropical diseases are quite common in the Balkanic zone. (2) The most important and the commonest of all is malaria, which is often of a very malignant type, and may simulate many other diseases. (3) Next to malaria, the amœbic and bacillary dysenteries are the most common affections. Causes of enteritis due to flagellates, and rarely to ciliates, occur. Coccidiosis has been observed. Cholera and paracholera have been rare. (4) Camp jaundice (*Icterus castrensis*) is common. (5) Fevers of the enteric group are fairly frequent in the Balkans, but during the last three years have never assumed an epidemic type. Paratyphoid A and B are in certain districts more frequently met with than true typhoid. Paratyphoid and similar fevers due to intermediate germs are not rare. (6) Malta fever is rare in Macedonia and the interior of the Balkanic zone; it is more frequently met with on the coast and in the islands. (7) Kala-azar of adults is absent in the Balkans; of the infantile type many cases are seen in certain islands of the Adriatic and Ægean Seas. In Macedonia it is rare. (8) Relapsing fever is quite common. In the treatment of the malady the best results were obtained by using a combined salvarsan-tartar emetic treatment. (9) Typhus exanthematicus is at the present moment very rare, whereas a terrible epidemic raged in 1914–15. Trench fever is occasionally met with; both the types described in France have also occurred in the Balkans. (10) Pappataci fever is extremely common in certain parts of the Balkans, especially in the late summer and early autumn. (11) Bronchomycosis and bronchospirochætosis are far from rare. (12) Pellagra is quite common in several districts of Macedonia. (13) Of the tropical diseases which are of rarer occurrence in the Balkans may be mentioned blackwater fever, filariasis, leprosy, sprue, intestinal myiasis, mycotic, spirochætic, and flagellate erethritis. (14) Certain tropical skin diseases are frequently met with.

Aristotelian Society, January 6.—Prof. Wildon Carr in the chair.—C. D. **Broad**: Mechanical explanation and its alternatives. Controversies between mechanistic and non-mechanistic biologists suffer from a lack of clear definition of what the opponents mean by mechanism. The case is also prejudiced by confining the controversy to biology, and not raising the same question about chemistry and other advanced sciences. Mechanism must mean at least obedience to the laws of motion or some substitute which reduces indefinitely near to them for moderate velocities. This condition is summed up by the form of Lagrange's equations and the form of the function T and the nature of the variables in it. But this is never a sufficient condition of mechanism; for it leaves open to the right-hand side of Lagrange's equations all sorts of forms and all sorts of variables. According to the different limitations imposed on their functions and their variables, different senses of mechanism emerge. Five senses are distinguished; the two least rigid are macroscopic, the remaining three are microscopic, in Lorentz's sense of these words. If the more rigid forms hold at all, they must hold microscopically, for it is certain that they do not hold macroscopically. Microscopic explanations need not be mechanistic. Only the less rigid forms of mechanism are necessary for scientific explanation, and they are not necessary for any profound metaphysical reason, but because we can accurately measure only directly geometrical magnitudes, and we cannot deal with a multitude of complex and irreducible laws. Even the most rigid form of mechanism might, however, be true if we carry our microscopic analysis further than it has yet been carried. The main advantage of pure mechanism would be a unification in our theories of Nature. Without it science is perfectly possible, but will take the form of a hierarchy of laws of various degrees of generality; the more special of these will not be deducible from the more general. When account is taken of secondary qualities it is seen that pure mechanism cannot be the whole truth even about the non-mental part of the world. There is no necessary conflict between teleology and mechanism; and the ultimate cause of the special structure of teleological systems is inexplicable with or without mechanism.

Optical Society, January 9.—Prof. F. J. Cheshire in the chair.—Lt.-Col. **Williams**: Design and inspection of certain optical munitions of war. Service instruments must be much more robust than those used by civilians, and have certain parts interchangeable. As regards optical systems, the definition is tested by means of plates having round and square holes and radiating grooves cut in them; the magnification by means of a dynameter; the field of view and spacing of graticules by means of scales; the normal focus by means of an auxiliary telescope; the diopter scales by means of standard lenses, etc. Much trouble has been experienced due to lenses, prisms, etc., in enclosed instruments having become filmy after a time.

DUBLIN.

Royal Dublin Society, December 17, 1918.—Prof. G. H. Carpenter in the chair.—Dr. Joseph **Reilly** and W. **Hickinbottom**: Determination of the volatile fatty acids by an improved distillation method. Assuming Nernst's law of distribution, the theory of distillation of a dilute aqueous solution of a volatile substance has been considered. The distillation constants of Naumann and Müller, Stein, and others have been correlated, and it is demonstrated that they are dependent on Nernst's law. The lower fatty acids were taken as a type of volatile substances soluble in water, and comparative distillation constants both for single acids and mixtures of acids have been determined. The apparatus used was of an improved type, in which the distillation was carried out at constant volume, the whole apparatus being steam-jacketed. Water was added through a side tube sealed into a quartz distillation flask at a point below the surface of the solution. A comparison was made with the methods employed by Duclaux, Dyer, and Stein. It is shown experimentally that the distillation constant is inversely proportional to the volume. It is also observed that there is a relation between the distillation constants and the molecular weight. From an examination of the percentage of acid distilled over in each fraction, from solutions of mixtures of two or three fatty acids, it is shown that the composition of the original mixture can be calculated with a fair degree of accuracy, thus affording an experimental verification of Nernst's law. This method of distillation is capable of being extended to the distillation of substances other than the lower fatty acids.—Miss Margaret G. **Flood**: The exudation of water from the leaf-tips of *Colocasia antiquorum*. Under normal conditions the leaf-tips of this species emit a succession of drops of liquid water (10–120 to the minute). In view of the extreme purity of the water expelled, as shown by cryoscopic and conductivity tests, the mechanism of the secretion and filtration is of interest. It has been generally supposed that a gland at the leaf-tips is responsible for the exudation, but minute microscopic investigation has shown that no such gland is to be found in the leaf-tip, and this histological evidence is confirmed by experiments in which colloids have been induced to flow through the tips, thus physically demonstrating a continuous passage from the water channels in the leaf through the tips. Hence we must assume that the exuded water is raised and filtered by the activity of tissues lower down in the plant.—Dr. G. H. **Pethybridge**: Preliminary note on the possibility of distinguishing the seeds of wild white clover from those of ordinary white clover by chemical means during a germination test. Mirande showed that *Trifolium repens* contained a cyanophoric glucoside. H. E. and E. F. Armstrong and E. Horton found that traces of HCN could be detected in the green cotyledons of young seedlings derived from the seed of wild white clover even on the fourth or fifth day after germination, but not in plants raised from ordinary or "cultivated" seed at any stage of growth. It was therefore thought that by using Guignard's alkaline picrate-paper it might be possible to distinguish the seedlings of wild white clover from those of ordinary clover with certainty during a germination test. Extended trials showed, however, that the seedlings from wild white clover-seed were not alone in giving a positive reaction for HCN, but that seedlings raised from commercial varieties of ordinary white clover-seed of American and Canadian origin also gave a positive reaction. Hence this reaction cannot be regarded as infallible as a means of differentiating between ordinary and wild white clover-seeds.—E. J. **Sheehy**: Possible causes of variation in the quantity and quality of cow's milk. An account is given of experiments conducted in 1918, supplemental to the earlier work of 1915 and 1916. One experiment shows that the proportion of solids not fat in milk decreases from the first sample drawn at a milking to the "strippings," while the percentage of fat increases. The milk becomes concentrated in solids not fat while it is resting in the udder. The second experiment shows the effect of leaving the "strippings" with a cow for some days. By comparing the above with the results from the injection of pituitary extract and corpus luteum, the conclusion is come to that fat is stored up in the alveolar cells of the mammary gland, owing to the back pressure of the milk in the udder, and that some of it remains there even after milking a cow thoroughly. Because more is left after the morning milk, succeeding a long interval, than after an evening milking, as much total fat is produced in the evening as in the morning milk.

SYDNEY.

Royal Society of New South Wales, November 6, 1918.—Mr. W. S. Dun, president, in the chair.—G. P. **Darnell-Smith**: An account of some preliminary investigations on a bacterial disease of tobacco. Blue mould, due to the fungus *Peronospora hyoscyami*, is a serious disease in tobacco seed-beds, and has been very prevalent in New South Wales during the last two years. While the mould itself causes a withering of the leaves, it has been found that the conducting vessels of the roots and stems invariably show signs of decay in plants that have been attacked. From the tissues of such plants pure cultures of a bacterium have been obtained which has the form and many of the characters of *Bacterium solanacearum*. Cultures of this organism inoculated into healthy plants have been recovered again after two months. There seem to be grounds for believing that the main difficulty in rearing plants that have been attacked by blue mould lies in the fact that they become infected with a bacterium identical with, or closely allied to, *Bacterium solanacearum*, an organism which in America has been shown to give rise to a wilt disease of tobacco.—R. H. **Cambage**: Two new species of Eucalyptus. One species was a Mallee from the hills near Pokolbin, in the Maitland district, and the other a tree up to 50 ft. high, known as the willow gum, from the summit of the Buffalo Mountains in Victoria, at an elevation exceeding 4000 ft.

WASHINGTON, D.C.

National Academy of Sciences, August, 1918 (Proceedings, vol. iv., No. 8).—C. B. **Davenport**: Hereditary tendency to form nerve tumours. The disease is not communicable. It affects blood-relatives, both sexes nearly equally, and occurs without a break in the generations, about 50 per cent. of the individuals being affected. Apparently, therefore, the hereditary factor in neurofibromatosis is dominant.—D. N. **Lehmer**: Arithmetical theory of certain Hurwitzian continued fractions. Investigations on the successive values of the numerators and denominators of convergents.—A. **Emch**: Closed curves described by a spherical pendulum. Some geometric properties of these curves are developed.—C. **Drechsler**: The taxonomic position of the genus Actinomyces. A morphological study for the purpose of determining the merits of various contending views.—H. **Shapley**: Studies of magnitudes in star clusters—viii. A summary of results bearing on the structure of the sidereal universe. A summary of results leads to a simple interpretation of star-streaming. The stars of stream i. belong to the large moving cluster surrounding the sun, those of stream ii. belong to the galactic field.—H. L. **Fairchild**: Glacial depression and post-Glacial uplift of North-Eastern America. An illustration of the geophysical theory of isostacy.—C. B. **Lipman** and D. D. **Waynick**: A bacteriological study of the soil of Loggerhead Key, Tortugas, Florida. A discussion of bacterial counts, nitrogen-transforming powers of the soils, and nitrogen-fixing powers and organisms.—P. H. **Cobb**: Autonomous responses of the labial palps of Anodonta. The palp contains within itself the neuromuscular organism necessary for the responses described, and therefore possesses an autonomy more complete than that of the vertebrate heart.—F. C. **Blake**: The depth of the effective plane in X-ray crystal penetration. In determining the value of h by means of X-rays, the "depth of the effective plane" was 0·203 mm. for calcite with a certain X-ray wave-length. An attempt is here made to explain this theoretically.—E. P. **Allis**, jun.: The myodome and trigemino-facialis chamber of fishes and the corresponding cavities in higher vertebrates.—D. F. **Jones**: The effect of in-breeding and cross-breeding upon development. A continuation of work by East and Hayes on the naturally cross-pollinated corn plant, *Zea mays*, L.

September, 1918 (Proceedings, vol. iv., No. 9).—W. M. **Davis**: Metalliferous laterite in New Caledonia. Laterite ores of the serpentine highlands seem to be local as to area of development, and intermittent as to time of origin and duration of occurrence.—H. H. **Donaldson**: A comparison of growth-changes in the nervous system of the rat with corresponding changes in the nervous system of man. The five events in the growth of the nervous system of the rat, namely, (1) increase in total weight, (2) decrease in percentage of water, (3) accumulation of myelin, (4) maturing of the cerebellum, and (5) attainment of mature thickness of the cerebral cortex, all take place at ages equivalent, or nearly equivalent, to those at which they occur in man; and hence, by the use of equivalent ages, there is a satisfactory method for making a cross-reference between the rat and man.—R. W. **Hegner**: Variation and heredity during the vegetative reproduction of *Arcella dentata*. Within a large family of *A. dentata* produced by vegetative reproduction from a single specimen there are many heritably diverse branches. These diversities are due both to very slight variations and to sudden large variations or mutations. The formation of such hereditarily diverse branches seems to be a true case of evolution observed in the laboratory, and occurring in a similar way in Nature.—W. E. **Ekblaw**: The importance of nivation as an erosive factor, and of soil-flow as a transporting agency, in northern Greenland. Nivation and solifluction, characteristic processes of disintegration and denudation under sub-Arctic or Arctic conditions, appear to be of prime importance in the reduction of high relief of northern Greenland.—G. A. **Miller**: The α-holomorphisms of a group. A solution of the problem: For what values of α is it possible to construct non-Abelian groups which admit separately an α-holomorphism?

October, 1918 (Proceedings, vol. iv., No. 10).—Major R. M. **Yerkes**: Measuring the mental strength of an army. A review of the psychological undertakings in connection with the examination of the recruits for the U.S. Army.—E. H. **Hall**: Thermo-electric action with thermal effusion in metals: a correction. Supplementary to an earlier paper.—E. J. **Wilczynski**: Invariants and canonical forms. A general proof in the sense of Moore's general analysis of the fact that the co-efficients of a unique canonical form are invariants.—E. L. **Nichols** and H. L. **Howes**: Types of phosphorescence. Two types of phosphorescence, known as *persistent* and *vanishing*, are distinguished and discussed. The types are apparently independent, and both may occur with a single source of excitation and in a single substance.—C. G. **Abbot**: The Smithsonian "Solar Constant" Expedition to Calama, Chile. A preliminary report on the aim and equipment of the Calama expedition.—C. B. **Bridges**: Maroon, a recurrent mutation in Drosophila.

CALCUTTA.

Asiatic Society of Bengal, November 6.—E. **Brunetti**: Review of progress in our knowledge of Oriental Diptera during the last two decades.—E. **Vredenburg**: The occurrence of *Cypraea nivosa*, Broderip, in the Mergui Archipelago. Among the shells from the Mergui Archipelago collected by Dr. J. Anderson, and described in 1888 by Dr. von Martens, are two specimens of the rare species *Cypraea nivosa*, Broderip, hitherto only known from Mauritius, that have erroneously been referred to *Cypraea vitellus*, Linn., which *Cypraea nivosa* superficially resembles. It is not unlikely that, as in the case of the Mergui shells, this uncommon species may have been mistaken in other instances for the common *Cypraea vitellus*.

BOOKS RECEIVED.

Catalysis in Industrial Chemistry. By Prof. G. G. Henderson. Pp. ix+202. (London: Longmans and Co.) 9*s*. net.

Fungi and Disease in Plants. By E. J. Butler. Pp. vi+547. (Calcutta and Simla: Thacker, Spink, and Co.) 15 rupees.

The Turks of Central Asia in History and at the Present Day. By M. A. Czaplicka. Pp. 242. (Oxford: At the Clarendon Press.) 15*s*. net.

A Bibliography of Indian Geology and Physical Geography. With an Annotated Index of Minerals of Economic Value. By T. H. D. La Touche. Part i. Pp. xxviii+571. Part ii. Pp. ii+490. (Calcutta: Office of the Geological Survey of India.) 5*s*. 4*d*. and 6*s*. respectively.

How to Deal with Different Kinds of Fires. By S. G. Gamble. Pp. 50. (London: The British Fire Prevention Committee.) 3*s*. 6*d*.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. Second edition. In 3 vols. Vol. i., Kinetic Theory. Pp. xii+494. Vol. ii., Thermodynamics. Pp. vi+403. (London: Longmans and Co.) 15*s*, net each vol.

Catalytic Hydrogenation and Reduction. By Dr. E. B. Maxted. Pp. viii+104. (London: J. and A. Churchill.) 4*s*. 6*d*. net.

Surface Tension and Surface Energy, and their Influence on Chemical Phenomena. By Dr. R. S. Willows and E. Hatschek. Second edition. Pp. viii+115. (London: J. and A. Churchill.) 4*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY OF ARTS, at 4.30.—H. Kelway-Bamber, M.V.O.: Coal and Mineral Traffic on the Indian Railways.

LINNEAN SOCIETY, at 5.—Capt. A. W. Hill: The Care of Soldiers' Graves.—N. E. Brown: Old and New Species of Mesembryanthemum, with Critical Remarks.—Dr. J. R. Leeson: Exhibition of Mycetozoa from Epping Forest.

MATHEMATICAL SOCIETY, at 5.—Prof. Fréchet: The Differential of Functional Operations.—L. J. Mordell: The Value of a Definite Integral.

CHEMICAL SOCIETY, at 8.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 5.30.—Sir J. Dewar: Liquid Air and the War.

MONDAY, JANUARY 20.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Lt.-Col. Winterbotham, R.E.: British Survey on the Western Front.

TUESDAY, JANUARY 21.

ROYAL INSTITUTION, at 3.—Prof. Spenser Wilkinson: Lessons of the War.

BRITISH ASSOCIATION GEOPHYSICAL DISCUSSIONS, at 5.—Dr. E. M. Wedderburn: Seiches.—Dr. S. Chapman: Tidal Motions in the Atmosphere.

ROYAL STATISTICAL SOCIETY, at 5.15.—Right Hon. Herbert Samuel: Presidential Address: The Taxation of the Various Classes of the People.

FARADAY SOCIETY.—*General Discussion*: The Present Position of the Theory of Ionisation.—At 5-6.30.—Prof. G. Senter: Introductory Address.—Prof. S. Arrhenius: The Evidence for Electrolytic Dissociation.—Prof. S. F. Acree: Some Investigations Bearing on the Present Position of the Theory of Ionisation.—Capt. J. W. McBain: Some Fundamental Problems of the Dissociation Theory in Aqueous and Non-aqueous Solutions.—W. R. Bousfield: The Determination of the Ionisation of an Aqueous Solution; Correction of the Transport Numbers for Combined Water.—Dr. N. R. Dhar: Some Aspects of the Electrolytic Dissociation Theory.—At 8.—Dr. Henry J. S. Sand: The Hydration of Ions.—Prof. A. W. Porter: The Variation of Electric Conductivity of Solutions with Concentration.—Dr. E. Newbery: The Resistance of an Electrolytic Cell.—Capt. J. R. Partington: The Dilution Law.—Dr. E. B. R. Prideaux: Pyrites and Ammonia—Estimation and Separation.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—Andrew Campbell and W. J. Wilson: Paraffin Wax and its Manufacture.

ILLUMINATING ENGINEERING SOCIETY, at 8.—A. Wise opens a Discussion on Modern Practice in Office Lighting.

WEDNESDAY, JANUARY 22.

ROYAL SOCIETY OF ARTS, at 4.30.—Col. H. G. Lyons: Meteorology during and after the War.

GEOLOGICAL SOCIETY, at 5.30.—C. J. Gilbert: The Occurrence of Extensive Deposits of High-level Sands and Gravels Resting upon the Chalk at Little Heath, near Berkhamsted.—G. Barrow: Notes on the Correlation of the above-mentioned Deposits with the High-level Gravels of the South of England (or the London Basin).

THURSDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Admiral Sir H. Jackson and Prof. G. B. Bryan: Experiments Demonstrating an Electrical Effect in Vibrating Metals.—Prof. T. H. Havelock: Wave Resistance: Some Cases of Three-dimensional Fluid Motion.—W. S. Abell: Chances of Loss of Merchant Ships.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. P. M. Fleming: Planning a Works Research Organisation.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 5.30.—Temp. Lt.-Col. A. Balfour: One Side of War.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

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NATURE

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

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THURSDAY, JANUARY 23, 1919.

DISEASES OF PLANTS.

Fungi and Disease in Plants: An Introduction to the Diseases of Field and Plantation Crops, especially those of India and the East. By E. J. Butler. Pp. vi+547. (Calcutta and Simla: Thacker, Spink, and Co., 1918.)

THE research work published from time to time by the staff of the Agricultural Research Institute at Pusa has shown a high standard, which is well maintained by this pioneer volume on the fungous diseases of field and plantation crops of India and the East, written by Mr. E. J. Butler, Imperial mycologist for India. When we realise what a dull book might have been compiled in the old "museum catalogue" manner, we gratefully extend a warm welcome to this volume, through which the spirit of research breathes so strongly.

The book is divided into two sections, and in each the numerous references made to the work of mycologists all the world over, and the excellent bibliography, are evidence of the wide reading of the author.

In part i. we have a clearly written introduction to the study of mycology, with chapters on the nature of fungi, their food, the life-histories of parasites, the causation of disease, and the principles of the control of plant diseases.

We have so few scientific data as to "conditions affecting the host" and "predisposition" that a satisfactory treatment of the subject is almost impossible. Mr. Butler states (p. 124) that "the mere growth of a plant under glass may reduce its resistance" to rust and mildew; just recently the converse has been proved to be the case with respect to the hop-plant and its mildew. Anyone who has studied the attacks of the oak-mildew in woods in England will find it impossible to believe the statement (p. 116) that "the injurious effect of factory smoke" is required to "lower the resistance" of this host-plant. Mr. Butler assumes that the new varieties of potatoes put on the market as "blight resisters" are all really so at the start, and that they "deteriorate" and become susceptible. It may be asked whether there was really scientific evidence of such original immunity, or whether it is not a common "trick of the trade" to describe new varieties as "blight resisters." We still remember the shock of finding *Septoria petroselini* and *Cercospora melonis* virulently infesting a new variety respectively of celery and cucumber, each described as "——'s Disease Resister"! That immunity does not "wear off," so to speak, appears to be proved with regard to certain varieties of potatoes which resist the attacks of "wart-disease" irrespective of the age of the variety or the vigour of the shoot. Again, in those cases where it appears that a parasitic fungus recently introduced into a country diminishes its virulence of attack, the possible explanation must not be lost sight of that —as with the chrysanthemum when its rust found its way into this country—the most susceptible varieties go out of cultivation and are replaced by more resistant ones.

Part ii. comprises "Special Diseases." Nearly 200 diseases of Indian crops are mentioned; each disease is given, first, a general description, admirably written for the needs of the "man on the land." The description of each growing crop and its particular disease has that invigorating freshness which the use of the field-notes of a keenly interested investigator alone can give. No planter could wish for better accounts of the "Tikka" disease of the ground-nut, of the seedling blight" of castor, and of the "red rot" and "wilt" of the sugar-cane; the author's strong, clear, descriptive style is also well shown in his treatment of the diseases of tea and rubber. After the general description of the disease, technical details are given sufficient to satisfy the needs of the student. The very numerous illustrations, many of which are from drawings of native Indian artists, or copies by them in ink or wash of Mr. Butler's fine pencil work, are exceptionally good: the sensitive drawings of leaves—*e.g.* in Figs. 124 and 127—are a delight artistically.

Many columns here could be filled with extracts from this book of great interest both from the economic and the purely scientific sides. We are enabled to realise the special difficulties of combating fungous diseases in such countries as India; to see "the spraying coolies who have to climb the trees"; to watch the distribution through the villages of Bombay of "one-anna packets of copper sulphate" (sufficient to protect against "smut" enough seed of "jowar" to sow four acres); and to admire the industry of those tea-planters who, over an area of 1300 acres, hand-picked and destroyed in two seasons more than 32 tons of leaves affected with "blister blight" (Exobasidium). The money losses involved in many of the diseases is very considerable; the value of the grain of "jowar" destroyed by "smut" in Bombay alone is estimated to exceed a million sterling annually. Among a mass of interesting facts we may note the correlation of epidemics of wheat rust with the varying humidity of the air; the killing of the mycelium of *Phytophthora infestans* in the potato-tuber by the climatic heat of the plains; the marked parasitism of Cladosporium (which appears to be becoming a pest in England) on wheat and "jowar"; and the existence of specialised "flax" and "linseed" races of *Melampsora lini*. It may be pointed out that the general statement (p. 62) that "in black rust the æcidial form on the barberry has the same specialisation as the uredo-teleuto," while true as regards some countries, needs to be qualified by reference to the work of Arthur in 1910, which showed that in the United States the specialisation of parasitism has proceeded on different lines; the genus Oospora (p. 81) is now replaced by Actinomyces; the word "botanical" is used wrongly (pp. 60, 61) to mean "morphological"; the wall of the perithecium in the Erysiphaceæ does not gradually rot away (p. 273), but opens by a definite rupture; and it is very heterodox to state (p. 143) that the right way to mix the components of Burgundy mixture is exactly the same as with Bordeaux mixture.

High praise must be given to the printers for surmounting so successfully the special difficulties of printing which obtain at Calcutta; the misprints are so rare that the two noticed may be mentioned here—at p. 163 "rust-resting" is printed for "rust-resisting," and at p. 353 "sacospores" for "ascospores."

This work, which is particularly delightful in its readable quality, will inevitably become the "classical" book of reference for both the cultivator and the student of mycology in India. It would be well if in the next edition the author gave more information on "pure culture" methods, enriched as this would be by his intimate knowledge of how to overcome the difficulties that result from the special climatic conditions.

E. S. S.

THE DOUBLE-STAR WORKER'S VADE-MECUM.

The Binary Stars. By Prof. R. G. Aitken. Pp. xiv+316. (New York: Douglas C. McMurtrie, 1918.)

THIS book is issued as one of the series of semi-centennial Publications of the University of California. We are informed in the introduction that "the object of this volume is to give a general account of our present knowledge of the binary stars, including such an exposition of the best observing methods and of approved methods of orbit computation as may make it a useful guide to those undertaking the investigation of these systems; and to present some conclusions based upon the author's own researches during the past twenty years."

The spectroscopic binaries, and also the visual binaries, are regarded as "members of a single species," and the development in recent years of both sections has tended to show that "the only differences between the spectroscopic and visual binary stars are those which depend upon the degree of separation of the two components." Granting this, the compilation of such a volume as that now under review became inevitable; and no one man is more favourably equipped for the task than Prof. Aitken, who, while living in the midst of workers in the spectroscopic section, is himself the incarnation of the visual section. Although not mentioned here, eclipsing binary stars are also regarded as members of the family, and the exhaustive and interesting chap. vii., which the author devotes to them, certainly adds value to the book. There are at present about one hundred and fifty known, and the chapter is based on the researches of Russell and Shapley.

The substance of chaps. i. and ii. is historical, and the author proves that, in both visual and spectroscopic work, American observatories have made double-star astronomy peculiarly their own. It is indeed the fact, and explains why American astronomers are so prominent throughout the book.

Chap. iii. is devoted to observational methods and means, including the micrometer, resolving power, and personal equation. As one would expect, there is much sound and practical advice. On the working catalogue, a difficult subject, it is Prof. Aitken's deliberate judgment that, under average good observing conditions, the angular separation of pairs measured should be nearly double the theoretical limit. Of course, observers with the largest telescopes must not be bound by this, for if they do not measure the very closest pairs the time devoted to their discovery is wasted. The note on the non-use of diaphragms is short and sound. The reviewer found a neutral-tint glass at the eye-end a sufficient and more convenient help.

In chaps. iv. and vi. the author discusses fully the various methods in use for computing orbits of visual and of spectroscopic binaries respectively. He carefully points out the advantages of each method, giving many useful hints, and illustrations by concrete examples. These two chapters have been well considered and developed; they practically exhaust the subject.

Between these two chapters is another in which will be found a welcome description of the spectroscope and of the manner in which accurate measures of displacement in the spectral lines can be made, the photographic portion being illustrated by a minute account of the "Mills spectrograph." In chap. viii. is a table of eighty-seven visual binaries "divided into two groups, the first containing orbits which are at least fairly good approximations, the second the less accurate orbits." But as we are told that "several orbits included in either one of the two groups might find a place in the other," the division seems superfluous. These orbits have been selected in general because they are the most recently computed. There is also a table of 137 spectroscopic orbits, but only 119 are used in the discussions. From a number of interesting results we extract the following relations between the periods and eccentricities:—

46	spec. bin.,	mean period	2·75	days,	ecc. 0·047
19	,, ,,	,, ,,	7·80	,,	,, 0·147
25	,, ,,	,, ,,	23·00	,,	,, 0·324
29	,, ,,	,, ,,	1·5	years	,, 0·350
30	vis. bin.,	,, ,,	31·3	,,	,, 0·423
20	,, ,,	,, ,,	74·4	,,	,, 0·514
18	,, ,,	,, ,,	170·0	,,	0·539

A relationship so definite must have a physical significance. Later, on p. 221, it is shown that in the Cepheid variables this relation does not hold.

Treating of relative masses of visual binaries, Prof. Aitken remarks: "The most reliable values are those deduced by the late Lewis Boss," and the table on p. 216 is constructed on this idea, the work of several other computers being omitted. This is a pity, and the author himself is not convinced, for later he tells us that Boss obtained a value of 1·8 for 85 Pegasi, but *adopted* 1·0; and on p. 233 he also points out that in Sirius we have a system in which is an even greater disparity between mass and luminosity in the two components, and he adopts Boss's computed value. Incidentally, this weakens one of the facts of observation made use of in discussing the "origin of the binary stars." Future progress is dependent on departures from our preconceived ideas.

In chaps. x. and xi. the author is more happy in dealing with his material—a large percentage being his own contribution during the last twenty years—and we are given a number of most interesting tables and results. Here are a few:—(1) At least one in every eighteen stars, on the average, in the northern half of the sky, which are as bright as 9·0 B.D. magnitude, is a close double star visible with the 36-in. refractor. (2) The percentages of double stars by magnitude classes are:

Mag. to 6·5	percentage 11·1	7·6 to 8·0	percentage 6·8
6·6 „ 7·0	„ 7·9	8·1 „ 8·5	„ 5·3
7·1 „ 7·5	„ 7·2	8·6 „ 9·0	„ 4·1

(3) Visual doubles are relatively more numerous in the Milky Way than elsewhere in the sky. (4) Visual binaries as bright as 6·5 magnitude are in excess amongst class G stars, and least in K and M. (5) Visual and spectroscopic binaries of every spectral class increase in numbers as the Milky Way is approached. (6) Spectroscopic binaries as bright as 5·5 magnitude are far the most numerous amongst stars of spectral type B.

To these are added, in chap. xi., the following from points brought out in the previous chapters: (7) The considerable percentage of multiple systems. (8) Close correlation between period and ellipticity. (9) Period and spectral type. (10) Relative brightness and relative masses of the two components. (11) Relatively great mass of a binary compared with the sun. (12) Spectroscopic binaries of class B, on the average, are three times as massive as those of later types.

All these and other minor points are discussed in connection with their bearing on the "origin of the binary stars." Of the three theories: (1) Capture, (2) fission, (3) independent nuclei, the author, having no alternative theory of his own, favours (2). The book contains a mass of interesting data well discussed. The physicist as well as the astronomer will find it a real treasury. It must also appeal to the wider circle of our readers.

THE SCIENCE OF IRON-FOUNDING.

Cast Iron in the Light of Recent Research. By Dr. W. H. Hatfield. Second edition, revised and enlarged. Pp. xvii+292. (London: Charles Griffin and Co., Ltd., 1918.) Price 12*s*. 6*d*. net.

THIS important work on the metallurgy of iron and steel has been enriched, in its second edition, to the extent of some forty-six pages of new matter, including thirty-nine fine reproductions of micro-structures. The chapter on "The Heat Treatment of Cast Iron" has been divided so that the annealing of grey cast iron is treated separately. The new matter includes Prof. Carpenter's valuable contribution on "The Effect of Working Temperatures on Parts of Internal-combustion Engines," the author's report to the Ministry of Munitions on "The Present Position of the Malleable Casting Industry in this Country"—an illogical but welcome inclusion—"The Influence of Sulphur in the Presence of Silicon" (chap. xv.), and "The Limits of Phosphorus in Malleable Castings" (chap. xvi.).

A careful perusal of this work suggests that not much research, recent or ancient, has escaped notice, and everything worthy of note on the theoretical or the quasi-practical side of cast iron is included within the covers of the book. The difficulty is to locate and isolate in a concise form any particular information required. The impression is created that the author has been more or less overwhelmed by the mass of data collected. This results in a sense of uncertainty and a tendency to confusion in the mind of the reader. The author, who is undoubtedly an expert in his subject, would be well advised in any future edition to set out clearly a summary of each chapter, even more fully than has been done in the two new chapters, which in this respect are fairly well equipped.

The portions dealing with heat treatment, especially that which treats of malleable cast iron, bear the true impress of authority, and when this idea is conveyed by the rest of the book it should become the standard work on the metallurgy of cast iron as distinct from iron-founding. All such works should bear the hall-mark of a convincing personality.

The technically trained practical man will find great help in fitting himself either to meet specifications or to account for failures. Graduates and others seeking promising fields of research will find them in plenty, whilst those who delight in public controversy, provided they have easy access to a scientific library (so that the all-too-numerous references may be turned up), will be in clover. In the hope that this book may become the standard classic, we suggest that careful attention should be paid to what may appear to be matters of detail. For example, several graphs do not show clearly the increments which constitute the co-ordinates, and analyses occasionally are far from complete.

It is to be regretted that the chapter on mechanical properties is included in its present form. This should be entirely re-written. Even the pressure of war-time duties does not excuse the use of such terms as "breaking strain in tons per square inch" and "compressive strain." Admitting that cast iron is almost devoid of ductility, "breaking load" is not the correct expression. Again, in dealing with the transverse test, too little attention is paid to the relative value of the maximum stress under the two recognised standard conditions, and there is no reference to any correction for slight variations in sectional area, whilst undue prominence is given to the maximum load on section calculated to tons per square inch, which form of report is of very doubtful use.

Dr. Hatfield is to be heartily congratulated on this work as a whole.

OUR BOOKSHELF.

A Modern Pilgrim in Mecca. By Major A. J. B. Wavell. New cheaper impression. With an introduction by Major Leonard Darwin. Pp. xv+232. (London: Constable and Co., Ltd., 1918.) Price 2s. 6d. net.

FEW Christians have been to Mecca, and fewer still to Medina, or, if they have attempted the journey, have survived to tell the tale. Here is the story of how a young man of twenty-six successfully accomplished the feat. Major Wavell, travelling in disguise *via* Beyrout and Damascus, reached Medina by the Hedjaz railway in 1908. After some weeks' stay in that city, where he had one or two narrow escapes from detection, he made his way by camel caravan to Yemba, on the coast, the overland route to Mecca being closed, owing to the rising of the Bedou tribes. From Yemba Major Wavell went by sea to Jiddah, and thence reached Mecca. His stay in Mecca seems to have been safer than in Medina, but not without risks. The pilgrimage to Mina was made before the return to Jiddah and the departure for Egypt. The book is full of information; many pages glow with colour, and not one lacks fascination. As the author says of himself, he was "never averse to being where anything interesting is taking place." That is the spirit in which he carried out this dangerous enterprise. His two companions were an Arab from Aleppo and a Mombasa Swahili. To avoid the chance of detection, he adopted the expedient of telling Arabs that his language was Swahili, and when he met natives of East Africa, of saying he was from Muscat and spoke only Arabic.

The book has an introduction on the geography of Arabia, with an account of Mohammedanism. Major Leonard Darwin contributes a short life of this daring soldier, whose brilliant career ended at the age of thirty-four, when he fell in action in East Africa at the head of the Arab corps which he had raised. The present edition is a cheap reprint; it has a map, but no illustrations. It is to be hoped that in the rising tide of war-books this fascinating volume will not be overlooked.

A Junior Course of Practical Zoology. By the late Prof. A. Milnes Marshall and the late Dr. C. Herbert Hurst. Eighth edition, revised by Prof. F. W. Gamble. Pp. xxxvi+515. (London: John Murray, 1918.) Price 12s. net.

IN the new edition of this well-known and excellent manual amœbæ from the soil are recommended for study as a substitute for the larger species *Amoeba proteus*, when this is not available, and two types not hitherto included—the large trypanosome of the dogfish and a tapeworm—are described. Careful directions are given for preparing a culture of the soil amœbæ and for obtaining trypanosomes by centrifuging the blood of the dogfish, the trypanosomes present being carried down with the blood corpuscles to the bottom of the tube, whence they can be withdrawn with a pipette for examination in a drop of the plasma.

In the account of the encystation of Amœba reference is made to the reproductive cysts from which issue "in one marine species at least . . . minute flagellated spores which conjugate in pairs and form amœbulæ." This statement relates, however, to a species of Paramœba, and as the account is headed "*Amoeba proteus*" it would have been better to refer to Miss Carter's observations on the reproductive cyst of this species from which amœbulæ were found to issue.

The kinetonuclear end of the trypanosome is regarded as anterior—a view which is not usually held. Although trypanosomes often move with this end in front when among a mass of corpuscles, the flagellum is usually anterior when free movement is possible.

There is a slip on p. 16, where it is stated that the zygote of Monocystis "divides four times, producing eight sporozoites"—there are, of course, only three successive divisions—and the statement on p. 33 that some of the buds of Obelia "have no mouth and become medusæ" is loose.

In the section of the work on vertebrates the principal change is the insertion in the text describing the rabbit's skull of a figure of the dorsal, and another of the ventral, aspect of the dog's skull.

How to Deal with Different Kinds of Fires. Some Hints by Sidney G. Gamble. Pp. 50. (London: The British Fire Prevention Committee, 1918.) Price 3s. 6d.

THE type of man generally placed in charge of works and property cannot be expected to have either the necessary experience or knowledge to enable him to direct advantageously or deal efficiently with an outbreak of fire, especially if the materials are not the ordinary combustibles, but chemicals, forage, coal, and the like. To assist these men and others the British Fire Prevention Committee has issued this Red Book, which is No. 201 of the committee's publications. Mr. Gamble, who until 1918 was second officer of the London Fire Brigade, gives in the first part of the book general information, and the effect of water, steam, chemicals, and so on, applied from different forms of fire appliances. The second part of the book deals alphabetically with numerous materials and kinds of fire in turn. Useful scientific data have been added, while an appendix on spontaneous combustion and a list of enactments bearing on the fire question complete a very useful compilation.

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.*]

Wireless Telegraphy and Solar Eclipses.

JUST before the beginning of the war in 1914 the Radiotelegraphic Committee of the British Association, which was appointed at the Dundee meeting in consequence of a suggestion by me, had completed arrangements for certain observations to be made on the strength of radiotelegraphic signals on the line of totality of the 1914 solar eclipse which passed through Russia. These arrangements were rendered useless by the outbreak of the war. On May 29 of this year a total solar eclipse will be visible in North Brazil, and it seems very desirable that any eclipse expeditions sent out to observe it should be provided with wireless telegraph apparatus, and should arrange to receive, and also to send, signals to other stations before, during, and after the passage of the moon's shadow.

It is very important to ascertain, if possible, whether there are any effects on signal strength due to the passage of the moon's shadow over a station such as accompany the diurnal passage of the earth's shadow at sunrise and sunset. Evidence obtained from long-distance wireless transmission points conclusively to the close connection between it and the ionisation of the upper regions of the atmosphere. There is time now to make arrangements for the erection of temporary wireless stations on the line of totality of the eclipse, and to arrange a programme of operations. May I suggest to those organising eclipse expeditions the desirability of doing this? J. A. FLEMING.

University College, London, January 14.

The Neglect of Biological Subjects in Education.

THE resolution of the Headmasters' Conference and Headmasters' Association, referred to in NATURE of January 9 (p. 379), that school instruction in natural science should include biology as well as chemistry and physics, reminds me of an impression which has been with me for some time that a similar reform is needed in our higher education. Arising, I suppose, from the curious notion that chemistry and physics are more exact and educative and of more general moment in the lives of animals than are botany and zoology, it is laid down at Oxford, for example, that a student who proposes to take a biological subject for his final school must pass an elementary examination in chemistry and physics, while if he specialises in chemistry or physics he is exempt from any preliminary course in biology. Something similar is, I believe, a pretty general regulation in all the universities in this country—and if not a regulation, at any rate a habit. The result is that a number of chemists are produced who are fearfully ignorant of the simplest truths of biology; they do not even know what biology is about or the general methods whereby a biologist will seek to solve his problems.

It is probably too much to ask that the education of those who devote themselves to the pursuit of natural knowledge should be such as would generate in them that sympathy with arts studies which we need so much, but we can at least try to secure that the various departments of natural science should be more sympathetic with one another's aims. Sympathy comes from understanding, and I think a considerable step in the right direction would be made by having compulsory instruction in botany and zoology as well as in chemistry and physics for *all* students in our schools of natural science. The reform is quite simple and would present no practical difficulties, which is more than can be said for some projects of reconstruction. A. E. BOYCOTT.

17 Loom Lane, Radlett, January 13.

The Aurora Borealis of December 25, 1918.

THE aurora borealis of December 25, 1918, was manifested here from 5h. 45m. to 11h., and among the more interesting features presented may be mentioned the great arch of light, with its apex at roughly N.N.W., having a dark transparent interior with the stars shining therein. The light nebulous clouds outside the arch, alternating rapidly in intensity, as well as the radial pulsating streamers, were especially noteworthy.

FIG. 1.—The aurora borealis as seen at Bramley, Yorkshire, on the night of December 25, 1918.

The accompanying illustration gives an approximate idea of the phenomenon as seen here. Vega is shown within the arch. SCRIVEN BOLTON.

Waterloo Lodge, Bramley, Leeds,
January 10.

PATENT LAW AMENDMENT.

A BILL to amend the Patents and Designs Act, 1907, was presented to the House of Commons by Sir Albert Stanley, President of the Board of Trade, as a Government measure in the latter part of 1917. This Bill was ordered to be printed on November 19, 1917. Considerable modifications in the 1907 Act are proposed in clauses 1, 2, 11, 14, and 17 of the Bill. These clauses provide new sections to replace sections 24, 27, 58, and 84 of the Act, the marginal notes whereof are respectively "Compulsory licences and revocation," "Revocation of patents worked outside the United Kingdom," "Cancellation of registration of designs used wholly or mainly abroad," and "Register of patent agents," and for the addition of a new section (38A) under Part I. of the Act.

The new section 24 makes provision, under safeguards, for patents, at any time after sealing, to be endorsed, at the request of the patentee, with the words "licences of right." After a patent has been so endorsed, all persons become entitled as of right to the grant of a licence to work the invention covered by the patent. Provisions are included in this section for the fixing of the terms of the licence, in default of express agreement between the patentee and the licensee; for the prevention of the importation into the United Kingdom by the licensee, in certain cases, of goods that would be an infringement of the patent; and for dealing with cases of infringement by unlicensed persons.

The new section 27 makes provision for ensuring that patented inventions shall be worked on a commercial scale within the United Kingdom, and empowers the Comptroller, in a proper case, either to endorse a patent with the words "licences of right," regardless of the wishes of the patentee, so as to bring it within the operation of the new section 24; or to grant a licence on such terms as he may deem expedient, or even to revoke a patent.

The new section 38A provides that articles intended for food or for medicinal or surgical purposes, or capable of being used for the production of food or medicine or of surgical appliances, shall not be patentable, although the processes for making foods, drugs, and medicines remain patentable as heretofore.

The proposed new sections 58 and 84 call for no special remarks here.

Among the other modifications introduced by the Bill there are, *inter alia*, new provisions (*a*) for the settlement of differences and disputes in relation to the grant and sealing of patents (cl. 5); (*b*) for increasing the original term of the patent from fourteen to fifteen years (cl. 6); (*c*) for amending section 18 of the principal Act so as to allow of an extension of the term of a patent on grounds attributable to circumstances connected with war (cl. 7); (*d*) for the grant of relief in infringement actions where the court finds any one or more claims are valid (cl. 8); (*e*) for depriving a plaintiff in an infringement action of relief by way of an account of profits (cl. 9); (*f*) for the exclusion of evidence in the courts in relation to an assignment of a patent unless the same has been recorded on the register of patents (cl. 15).

The 1917 Bill was introduced in the House of Commons in the spring of last year by the President of the Board of Trade, but was not proceeded with.

In February of last year the Institution of Electrical Engineers appointed a committee (*a*) to consider the provisions of the 1917 Bill, and (*b*) to report on the question of Patent Law Amendment generally. The report of this committee, which was composed of well-known members of the legal and engineering professions, and sat under the chairmanship of Mr. W. M. Mordey, has, with slight modifications, been recently published by the Institution of Mechanical Engineers. In an introductory note thereto it is explained that many of the technical and scientific societies, either representative of, or closely connected with, the great industries of the country, set up committees to examine the 1917 Bill; later, on the invitation of the president of the Institution of Mechanical Engineers, a conference, attended by representatives of twenty-six institutions and societies, was summoned, and held several meetings for the purpose of securing, if possible, united action in relation to the Bill in question. The Institution of Electrical Engineers placed the report of its committee at the disposal of this conference, the members of which, having approved the principles contained therein, adopted it as the basis of a memorandum on Patent Law Amendment and arranged, in connection therewith, for a deputation to wait on the Board of Trade. The deputation was received, on October 10, 1918, by the Rt. Hon. G. J. Wardle, M.P., then Parliamentary Secretary to the Board, in the unavoidable absence of the President, Sir Albert Stanley.

The Parliament in which the 1917 Bill was introduced having been dissolved, it is extremely improbable that this Bill will ever be revived in its present form; however, the criticisms on this Bill and the suggestions contained in the report of the committee referred to above continue to be of importance, in view of the legislation in relation to the amendment of the Patent Law which may be proposed in the future.

The committee, in an introductory statement in the report, sets out the main principles and considerations by which it has been guided in carrying out its task. It points out that, in the interests of industrial enterprise, a twofold duty rests on the State in relation to invention, viz.: (*a*) to provide encouragement to the inventor, and (*b*) to provide also an incentive to capitalists to assist in the commercial development of inventions. It expresses the opinion that during the past quarter of a century the effect of legislation in this country has been to act as a deterrent rather than as a stimulant to invention, and urges that "every effort should be made to reduce, if not remove, the number of weapons available to people here and abroad, especially the latter, for attacking patentees who own real inventions."

The committee points out that the amendments proposed to section 18 of the Act (extension of term of patent) in clause 7 of the Bill to meet war conditions have the effect of leaving matters practically *in statu quo*; the new provisions will continue to limit extensions of the term to inventions of special merit. It is of opinion that "the Bill perpetuates the evils of the present procedure, which are such that the number of petitions for extension presented annually is under ten." The committee feels that the situation created by war would best be met by a separate Patents Moratorium Act, wherein provision should be made for the automatic prolongation of patents for a period equal to the duration of the war.

The committee does not view with favour the new sections proposed in substitution for sections

24 and 27 of the Act. It would prefer to see section 27 ("Revocation of patents worked outside the United Kingdom") repealed, and section 24 ("Compulsory licences and revocation") altered by enacting that (i) petitions for grants of "compulsory licences" should be made to the Comptroller of Patents with a right of appeal to the courts, and (ii) provisions enabling patents to be revoked should be cancelled. It holds the view that it is "wrong and illogical that letters patent should be revocable on the ground of non-working, except with the consent of the owner. The only justification for revoking a patent is that it is invalid."

The committee also expresses the opinion that "the possibility of revocation on the ground of non-working is an incentive to blackmailers, and greatly detracts from the value of a patent for financial support." It believes that the alternative proposed by it would best meet the interests of invention and industry.

The committee disapproves of the provisions of the new section 38 A, which prevent articles intended for food or for medicinal or surgical purposes, etc., being patentable. It is pointed out that the effect of the new section would be to deter inventors and capitalists from devoting their time and money to the development of industries which are admittedly in great need of stimulation —industries, too, in which this country is notoriously behindhand.

The committee in express terms approves of the provisions contained in clauses 5, 8, 9, and 15 of the Bill (see *ante*). Its views on some of the other matters dealt with in the report are as follows:—The term of the patent should be fixed at seventeen years; the period within which the complete specification must be filed should be extended; the procedure in relation to the grant and sealing of patents should be improved; disappointment is expressed that no substantial alteration is made in the Bill for binding the Crown, and the suggestion is made that, in cases of user by the Crown of an invention, the patentee, in default of an express agreement on the subject, should be entitled to apply to the High Court to adjudicate upon his claim and to determine the terms in respect of such user; the prescribed fees for a full-term patent should be reduced, in view of the large annual surpluses of the Patent Office budget.

Finally, the committee advocates that a new tribunal should be set up to deal with litigation involving scientific and technical questions; a similar proposal has been made by the Federation of British Industries. The committee acknowledges the great ability of the judges of the Chancery Division and their willingness to try scientific cases, but it points out that "the views of the judges as to what is invention has varied to a degree which has made it nearly, if not quite, impossible for manufacturers to obtain definite opinions as to the chances of success in patent disputes." It is urged that "if industry is to flourish to the fullest extent there must exist machinery for adjudicating effectively upon actions involving technical matters."

The question of the creation of a new tribunal to deal with patent actions and kindred cases has been before the Bar Council during the past year; the executive committee of the Council received a deputation from the Law Society on the subject in January, 1918, and afterwards appointed a special committee to consider the matter. This special committee has held several meetings and presented a report, which is now under the consideration of the Bar Council; it is understood that the members of this committee, who are all well-known King's Counsel, are in favour of the proposal to create a new tribunal for the trial of patent actions and of cases involving great technical or engineering details.

There is much in the report of Mr. Mordey's committee with which those whose interests particularly centre in Patent Law will heartily agree; to many of the recommendations of this committee effect can be given without difficulty or further elaboration. The same, however, is not the case as regards the proposal to establish a special tribunal to deal with actions involving technical matters. The proposal to create such a tribunal is worthy of all support; however, its constitution and the field of selection from which the judge to preside over it is to be obtained are questions which will require very careful consideration. It must be borne in mind that no single judge, however versatile, can possibly be expected to possess a sufficiently wide range of scientific and technical knowledge to enable him to cope successfully with the great variety of matters which would find their way into a court of the kind in contemplation. The proper solution would be to create a permanent statutory panel of technical assessors as an adjunct to the proposed new tribunal. Assessors suitably chosen from this panel, in accordance with the requirements of any particular case, should sit in the proposed court to assist the judge trying an action by elucidating the technical aspects of the case.

A belief widely prevails that patent protection is valueless in this country; it is the existence of such a belief which points to the urgent need for a reform of our Patent Law; and it is essential that it should be recognised that no reform of our Patent Law will be satisfactory which does not include a revision of the law of novelty and the practice of examination founded on that law. Under the Statute of Monopolies novelty was confined to "prior user" *within the Realm*, and the patentee was granted his privilege, not *qua* "inventor," but *qua* "institutor," or importer of a manufacture new as regards practice within the Realm. It is essential that the position of the "institutor" should be now reaffirmed, not only in the Act, but also in the grant and petition.

Further, it must be borne in mind that not only have the special interests of the inventor and of the "institutor" or capitalist to be adequately protected by legislation, but also those of the consumer and of the Crown, as the agent of the public at large; the Patent Law requires to be so framed that each of these interests shall be provided with suitable safeguards. Therefore, whilst it is desirable that the ambit of a patent should be widened and its validity after introduction made less open to impeachment, there is no good reason for extending the present statutory term of a patent, which is founded on the old practice of apprenticeship; moreover, it must always be borne in mind that during the period of a strong monopoly all incentive to improvement is removed, a situation being created which is as much to the detriment of the inventor and of the capitalist as of the individual consumer, and of the State also.

NATURAL AND ARTIFICIAL CAMOUFLAGE.

In an interesting essay on "Camouflage" (*Scientific Monthly*, December, 1918, pp. 481–94) Mr. Abbott H. Thayer illustrates his well-known conclusions in regard to the cryptic coloration of animals that hunt or are hunted. In their "superhuman perfection" the concealing coats of wild animals have become the models for the camouflage corps of armies. The patterns which animals exhibit "always inevitably tend to conceal," and that in direct ratio to their strength—*i.e.* the degree of difference among the component notes. "Monochrome, no matter how grey, *reveals* its wearer against all backgrounds whatsoever (and most of all if these are monochrome) except a background which is an absolute repetition of itself." What is practically universal is background-imitation, the deceptiveness of which is overwhelming. Mr. Thayer illustrates this by interesting views of brook-scenes and wood-scenes photographed through a stencil of bird or beast. The creature has the garment of invisibility because its "costume is pure scenery." "All the patterns and brilliant colours on the animal kingdom, instead of making their wearers conspicuous, are, on the contrary, *pure concealing coloration,* being the *actual colour notes of the scene in which the wearer lives,* so that he really *is* Nature's utmost *picture* of his background." Even the scarlet bodice of the scarlet tanager, by being a perfectly unbird-shaped scarlet patch amidst the forest foliage, is effective because it corresponds with the sprinkling of single scarlet leaves throughout the trees.

Two points must be borne in mind: (1) that the costume of a creature that does not change much throughout its life will correspond with "an average and expectable type of scene"; and (2) that what catches our eye may be quite elusive to the animal the sight of which was to be deceived, for a skunk that may seem to man conspicuous has been coloured "for concealment from the small creatures on which he feeds, and above which he looms against the sky."

It may be questioned, however, whether we know very much about the vision of the small creatures referred to. And when to the conclusion: "This resultant background-imitation is practically the universal accomplishment of animals' patterns," Mr. Thayer adds: "I have been left alone in the world to point this out," many readers will naturally wonder where Alfred Russel Wallace, for instance, comes in! This is a historical question, however, and the aim of Mr. Thayer's essay is largely practical—namely, the statement of a law of camouflage. "Man has only to cut out a stencil of the soldier, ship, cannon, or whatever figure he wishes to conceal, and look through this stencil from the viewpoint under consideration, to learn just what costume from that viewpoint would most tend to conceal this figure."

That this is not the whole doctrine of camouflage is suggested by the recent exhibition of "dazzled" ships or models of ships at Burlington House, where Lieut.-Commander Wilkinson's devices were admirably illustrated. The curious patterns or designs which have been painted on so many merchantmen and patrol-boats were thought out by Commander Wilkinson—like Mr. Thayer, an artist—not to make the ship inconspicuous, but to break up its form in such a way as to make it difficult for an attacking U-boat to estimate the course. A vessel at rest near the cliffs of a fjord or against the background of a wooded island can be camouflaged in various ways so as to become inconspicuous, but the "dazzled" ships expressed another idea, and elaborate trials have shown that even old, experienced seamen are so deceived by the strange designs that their estimate of the direction in which the ship's bows are actually pointing is usually wrong, and sometimes ludicrously wide of the mark. It is probable that some bird-designs—*e.g.* white tail-feathers—may have the same effect of breaking up the form of the body, thus making it more difficult for hawks to take a sure aim.

DR. H. E. J. DU BOIS.

Dr. Du Bois, whose death occurred at Utrecht on October 21, has left behind him a record of valuable work in magnetism, in optics, and in radiation. It was especially the connection between magnetic phenomena and the polarisation of light which led him into optical fields of research. Thus his earliest paper published in the *Annalen der Physik und Chemie* in 1887 deals with magnetic circular polarisation in cobalt and nickel. In 1889 Dr. Du Bois made his first appearance at the British Association, which met that year in Newcastle, and gave an account of his experiments on the Kerr effect in magneto-optics, showing how it could be used in the measurement of strong magnetic fields. The complete paper was published in 1890 in the *Ann. d. Phys. u. Chemie* and in the *Philosophical Magazine* (vol. xxix., p. 253). This paper was noteworthy both for the novelty of the method used and for the admirable manner in which the method was worked out. The fundamental idea was to measure the magnetisation at the surface of magnetised spheroids of iron, nickel, and cobalt by its effect on polarised light reflected from small polished plane faces at various positions of the surface. The results obtained were at once a beautiful test of the theory of magnetic induction and an elucidation of the laws governing the Kerr phenomenon.

Another line of research which engaged Dr. Du Bois's attention, and on which he submitted a note before the British Association in 1892, was the action of thin wire gratings upon transmitted light and other forms of radiant energy. In association with Rubens he published two papers on this subject (*Ann. d. Phys. u. Chemie*, 1892, 1893). Dr. Du Bois also gave close study to the phenomena of magnetic screening, and communicated a series of instructive articles full of research to the *Electrician* (vols. xl. and xli., 1898). Much of his own work, as well as that of his contemporaries, will be found embodied in his book on "The Magnetic Circuit in Theory and Practice" (German edition, 1894; English edition by Dr. Atkinson, 1896). There is probably no other work in which the theoretical and practical aspects of magnetism are so ably welded together as in this important contribution to scientific literature. In Prof. Gray's review in NATURE of February 24, 1898, it is stated that the book "cannot be praised too highly as a piece of work sound from every point of view."

Dr. Du Bois did his earlier work in Strasburg University, but for many years he carried on investigations in his own private laboratory in Berlin. At the time of his death he had returned to his native land and was beginning his work at the new Bosscha laboratory at Utrecht. He was a frequent visitor at the British Association meetings in this country, and his tall, handsome figure and charming personality will long be remembered among his many friends. C. G. K.

NOTES.

WE understand that Sir Lazarus Fletcher will retire from the directorship of the Natural History Museum, under the age limit, on March 31. The office was made in 1856, under the style of Superintendent of the Natural History Departments, so that the Trustees of the British Museum might obtain the services of Sir Richard Owen, who supervised the planning of the new museum at South Kensington, and retired shortly after its completion in 1884. Under the style of director, Sir William Flower succeeded Sir Richard Owen, and he retired in 1898. For the next decade Sir E. Ray Lankester was director, and he was followed by Sir Lazarus Fletcher early in 1910. The task now falls on the Trustees of finding a worthy successor who shall maintain the high prestige of the museum among the corresponding institutions of the world. Public interest in the promotion of pure science has never been keener than at present, and naturalists will await with unusual eagerness the announcement of this new appointment.

FROM the *Times* of January 20 we learn that the Prime Minister is to receive a deputation which will put before him the case for a separate Ministry of Fisheries. We hope this deputation will get a more favourable reception than the one that waited on Mr. Prothero on November 27 last, and that it will not repeat the mistake made on that occasion, when it seemed to be taken for granted that the Minister had mastered the elaborate memorandum prepared by the National Sea Fisheries Protection Association, and that, in consequence, it was not necessary for the speakers to deal with the things that really mattered.

THE Conjoint Board of Scientific Societies has commenced the publication of a fortnightly Bulletin of Scientific and Technical Societies, giving a diary of forthcoming meetings, with titles of papers and discussions, together with a list of the constituent societies of the Board and their presidents. The Bulletin will prove a very convenient guide to scientific meetings being held day by day, and by issuing it the Conjoint Board is appropriately promoting the co-ordination of effort which is one of its main purposes.

CHEMISTS, especially those who have been engaged under the Ministry of Munitions, will be interested to learn that on the cessation of hostilities a letter of congratulation was addressed to Mr. K. B. Quinan, of the Munitions Explosives Department, by the president and secretary of the Institute of Chemistry, expressing on behalf of the fellows and associates their high appreciation of Mr. Quinan's services during the war. Apart from the fact that the great organisation developed for the production of explosives contributed very substantially to the success of the Allied arms, the institute recognises that through the technical training initiated by Mr. Quinan many chemists have gained experience which will prove of great benefit to them and to chemical industry when they come to devote their energies to the furtherance of the arts of peace.

DR. J. D. FALCONER, lecturer in geography in Glasgow University, who has been serving as a political officer in Nigeria since 1916, has been granted further leave of absence by the University Court, at the request of the Secretary of State for the Colonies, in order that he may act as the first director of the Geological Survey of Nigeria.

THE *Times* announces that Dr. F. G. Cottrell, chief metallurgist of the United States Bureau of Mines, who discovered a new process for extracting helium from natural gas, has been awarded the Perkin medal for distinguished services in applied chemistry by the American Chemical Society.

PROF. MARTY, whose death at the ripe age of eighty-four was recorded a short time ago, was a member of the Académie de Médecine, and to a past generation was well known in France as a pioneer of hygiene and food chemistry. Much of his work was carried out for the information of the military authorities in safeguarding the health of the French Army. For this purpose Prof. Marty made numerous analyses of the water supplied to military hospitals, and also of the beverages and foods used. He gave special attention to the subject of "plastered" wines and to the sophistication of wine with coal-tar colours and salicylic acid. One result of Prof. Marty's studies was the fixing of a limit (2 grams per litre) for the quantity of potassium sulphate to be permitted in French wine; since 1880 this limit has been generally adopted in other wine-producing countries. Working with a coadjutor, he showed that hydrocyanic acid was present in tobacco smoke, and he also investigated the antiseptic action of air charged with phenol vapour as used in Lister's spray treatement. Many contributions from Prof. Marty's pen, dealing with the chemistry of coffee, chocolate, water, and spirituous beverages, appeared in the "Traité d'Hygiène" of Michel-Lévy.

THE Republic of Brazil has lost one of its most enlightened benefactors by the death of Dr. Rodrigues Alves, aged seventy years. Dr. Alves was born at San Paulo, and devoted his life to the public service. He appreciated fully the necessity of applying the discoveries of science to the welfare of a community living in the tropics, and when he was President of Brazil from 1902 until 1906 he so improved the sanitary condition of the ports that yellow fever was banished from them and they became comparatively healthy. Those especially who remember Rio de Janeiro at the end of last century, and also know its present condition, can realise the importance of Dr. Alves's reforms. To promote an adequate circulation of air, he caused a wide thoroughfare to be cut through the densest part of the old city. Swamps and waste ground, particularly on the margin of the bay, were transformed into dry promenades and fine gardens. Main drainage was attended to, and a sanitary service was established to undertake, among other duties, the pouring of oil on stagnant water. The intellectual life of the people was also fostered by the building of a national library and a national art gallery. Dr. Alves was elected for a second time as President last year, but failing health, unfortunately, compelled him to resign soon after this unique compliment had been paid to him by his grateful country.

WE regret to notice the announcement of the death on January 13, in his seventy-fifth year, of Dr. W. Marshall Watts, who was well known for his valuable contributions to the literature of spectroscopy. Dr. Watts was educated at Owens College, Manchester, where he studied under Sir Henry Roscoe, and he afterwards worked for some time in Bunsen's laboratory at Heidelberg. For thirty-three years he was science master at Giggleswick Grammar School, and after spending the early years of his retirement near London he removed to Southend, where he died. It was doubtless his association with Roscoe and Bunsen during the early development of spectrum analysis which led Dr. Watts to devote himself to the advancement of this subject. He made several original investigations, especially in connection with the spectra of compounds of carbon, but he will be best remembered for his "Index of Spectra," which first appeared modestly as a single volume, and has since been supplemented from time to time by a large number of appendices. The selection and arrangement of the data for these publications were made with excellent judgment, and the tables have greatly facilitated the work of investigators in this branch of science. Dr. Watts will also be gratefully remembered by many workers for the kindness with which he was always ready to place his special knowledge at their disposal. In recognition of his services to scientific investigation he was awarded a Civil List pension three years ago.

WE regret to notice the death of Prof. Gustave Bouchardat, which occurred recently in Paris. Prof. Bouchardat was formerly professor of hydrology and mineralogy in the Paris School of Pharmacy, and retired from this position some six years ago. His name has long been associated with the literature of synthetic rubber, a paper of his on this subject having appeared (in the *Comptes rendus*) so long ago as 1875. Camphor and borneol were some of the chief matters to which he had devoted attention, especially as regards the synthetic borneols and *iso*borneols. The action of acids on various terpenes was also a subject which he investigated. Prof. Bouchardat was born in 1842, and had been connected with the School of Pharmacy for about forty years.

BY the death, at the age of seventy-four, of Sir Gooroo Dass Banerjee, India has lost one of the most distinguished and universally respected Bengalis of our day. After a distinguished career at the Presidency College, Calcutta, Sir Gooroo Banerjee became a Vakil of the Calcutta High Court, and took an active share in the business of the city municipality. After holding a seat in the local legislature, he was raised to the High Court Bench, where he established his reputation as a sound lawyer. He was a member of the council of the Calcutta University, of which he acted as Vice-Chancellor, and he served on Lord Curzon's University Commission, to the report of which he contributed a characteristically independent note of dissent. He was a learned investigator of Hindu mathematics and Indian law and sociology—subjects dealt with in a long series of books. He combined plain living with high thinking to an exceptional degree. Sir Gooroo Banerjee has left four sons, all of whom hold high positions in the public life of Bengal.

THE death is announced of Mr. W. P. G. Graham at the age of fifty-seven. Mr. Graham entered the Royal Army Medical Corps in 1887, joined the Egyptian Army in 1890, served in the Tokar campaign of 1891, and in 1896 volunteered his services during the serious outbreak of cholera, after the cessation of which he accepted a post in the Egyptian Civil Service. In 1902 Mr. Graham was selected to reorganise the municipality of Alexandria, and for two years acted as administrator of that city. He then returned to Cairo, and was Director-General of Public Health in Egypt from 1907 to 1914, during which period he installed a water supply for Cairo and did much for the health of the country. Mr. Graham retired from the Egyptian Civil Service in 1914, and became an inspector of the Home Office under the Vivisection Act. In 1915 he took out Lady Wimborne's hospital to Serbia, with which he worked for some months. He was then sent by the War Office to Egypt, but an accident necessitated his return home after a short time, and he resumed his work under the Home Office.

THE cultivation of fungi by termites in their nests to serve as food for their young and for the queen is well known, and good accounts of the nests and their fungi have been given by Mr. T. Petch in the Annals of the Botanic Gardens, Peradeniya, in 1906 and 1913. A further paper on the fungi of termite-nests has now appeared in the Philippine *Journal of Science* (vol. xiii., sect. C, No. 4, 1918) by Mr. W. H. Brown. Mr. Brown's account is illustrated by two good plates showing the termite nests, the combs composed of small balls closely packed together and made apparently from the excrement of the termites, and the fungi growing on them. The fungi appear to be the same as those found in Ceylon and in the East generally, and are a conidial form, *Aegerita duthei*, which covers the combs thickly; a Xylaria, probably *Xylaria nigripes*, which grows out from the comb and forms a regular tomentum; and an Agaric, *Collybia albuminosa*. The wide distribution of these three fungi in termite nests is remarkable.

THE establishment of a French "Kew Gardens" is the text of a leading article in the *Gardeners' Chronicle* of January 4. The famous Jardin des Plantes at Paris has now become enclosed by the growth of the city, and a new site of 1500 acres is proposed in the park of Versailles between the Trianon and the Forest of Marly. The new garden would consist of about 100 acres, devoted to botanical collections, and would in the first place include those subjects which are absent from the original garden in Paris. About 80 acres would be devoted to collections of fruit-trees and 250 acres to flowers and cultivation under glass. In addition, some 80 acres would be set apart for the installation of laboratories and for providing land for experimental purposes. The site suggested would appear to be an ideal one, as the soil is fertile, and the land belongs to the State and offers almost unlimited facilities for expansion. Moreover, there are already at the Trianon considerable collections of trees, dating from the time of Michaux. It might be added that the Trianon is sacred ground for the botanist, for there originated the natural system of classification of Bernard de Jussieu, which was developed by his nephew, Antoine Laurent de Jussieu, and afterwards further elaborated by Augustin Pyrame De Candolle. The system had its birth in the arrangement adopted by Bernard de Jussieu in the Royal Garden at the Trianon. The new project is being actively supported by the powerful French Touring Club.

PROF. H. H. DIXON (Scientific Proceedings of the Royal Dublin Society, vol. xv., p. 431) describes the microscopic characters of forty-five different kinds of timbers which have been classed under the name "mahogany." The name was originally applied to the timber derived from *Swietenia mahagoni* (Cuban, St. Domingo, and Spanish mahogany), a West Indian species, and from *S. macrophylla* (Honduras, Tabasco, and Colombian mahogany), a native of Central America, but it is doubtful if any of the timbers now on the market come from these sources, and certainly most of them do not. C. D. Mell has recently listed sixty-seven species of trees as supplying timbers the characteristics of which sufficiently coincide with the popular idea of mahogany to be marketed as that wood (U.S. Dept. of Agriculture, Bull. 474, February, 1917), and this list might be added to from our present knowledge. The mahoganies come from all parts of the tropics, and belong to very different families besides the Meliaceæ, to which Swietenia belongs. Prof. Dixon examines in detail the characters of these various timbers, and suggests a definition of mahogany to include all red or red-brown timbers in which the fibres of the adjacent layers cross each other obliquely, giving rise to a play of light and shade on longitudinal surfaces, known as "roe," thus greatly emphasising and enhancing the figure. In addition, a mahogany should have scattered wood-vessels, isolated or in small, mostly radial, groups; the parenchyma round the vessels should be narrow and inconspicuous, while the medullary rays are, on the average, well under 2 mm. in height, and not more than nine cells thick. In other respects the woods classed as mahoganies have very various properties; for instance, with regard to density, hardness, presence or absence of year-rings, pore-rings, size and contents of vessels, distribution of parenchyma, etc. Prof. Dixon gives a detailed description of the microscopic characters, and also 138 photomicrographic reproductions with a uniform magnification of 31 diameters.

THE columbines (Aquilegia) of North America form a very interesting group of some twenty-four species, which is described in detail, with good illustrations, in Contributions from the United States National Herbarium (vol. xx., part iv., 1918) by Mr. E. B. Payson. It is in the floral characters that the more interesting features are to be found, and the author draws a phylogenetic chart based on the length of the spurs and the character of the sepals and petals, which is instructive. The flowers in sixteen of the species are nodding with spurs less than 1·5 cm. long, while the remaining species have erect flowers with spurs ranging from 3·5 cm. long to those of *Aquilegia longissima*, which are from 10–15 cm. long. This species is probably the most highly developed in the genus, and is found in South Texas and Mexico. It is of interest to notice that when grown in eastern North America this species will not set seed unless artificially pollinated, which points to the length of spur being correlated with some insect in its native habitat which does not occur in other parts of North America. The author describes three new species and two new subspecies.

ALTHOUGH fungi, both fresh and dried, are largely used in Italian cookery, it would appear that much still remains to be done even in Italy in utilising them for food. The "Federazione Pro Montibus," of which the headquarters are at 113 Via del Seminario, Rome, publishes a pamphlet of twenty pages by Dr. Giulio Trinchieri containing practical instructions for collecting and preserving edible fungi. It is accompanied by illustrations of eight species. Of methods of preservation, drying is the most important, and might with advantage be practised more extensively over here even if only applied to the mushroom of commerce, which often goes to waste for lack of this simple expedient. The use of salt, vinegar, alum, and methods of sterilisation are also mentioned in the present pamphlet, which contains in addition a bibliography of some of the principal Italian books on the subject.

BRAZIL, among other countries, has suffered severely owing to the restriction of exports of coal and other fuel by Great Britain. On the other hand, this embargo has had the effect of directing attention to the vast fuel resources available in that State. Already working operations are in hand in some regions, and, according to the U.S. Commerce Reports, No. 276, various mining companies are being subsidised by the Brazilian Government to stimulate production, and the home-produced supply will be favoured by the authorities whenever possible in the future. Quite high-grade briquettes are being made from coal which has been "purified" by washing and crushing to reduce the ash-content. As regards fuel-oil, the Parahyba shale is reported to be richer than that of Scotland, the former producing 165 litres of crude oil per ton ($16\frac{1}{2}$ per cent. oil-content), while the latter produces 100 litres (10 per cent. oil-content). Portions of the shale suitable for distillation have already been found at a number of points. Various companies have been formed, and authorities have reported favourably on the fuel for motor-vehicle and boat driving. Re-afforestation schemes are also proposed for overcoming the fuel shortage, experiments having shown that eucalyptus trees can be successfully grown in Brazil so as to yield wood at the end of five years at a cost of about 3*s*. per cubic metre.

IN papers read before the American Society for Testing Materials recently, Dr. Henry M. Howe and Mr. A. D. Little discussed some aspects of the organisation of industrial research. Dr. Howe divided the four phases of research into selection, planning, execution, and interpretation. In order that all these conditions may be satisfied, there should be a wider appreciation of the exact functions that a research should fulfil and greater co-operation amongst the scientific and technical men and bodies concerned. For the selection of a research, prophecy and breadth of view are essential; planning requires imagination and administration; execution, skill and trustworthiness; and interpretation, a philosophical mind. After enumerating the aims of research organisation, Mr. Little admitted that industry must look to the higher institutions of learning for the determination of fundamental facts and constants, the development of theory, and the establishment of general principles. Research must be given greater prominence at such institutions to enable industry to recruit the proper type of worker for its own research problems. It is desirable to provide technical schools with more experimental plant on an *industrial* scale, so that students from the schools will be able at once to apply their research methods to the requirements of the industrial firm which they enter. In conclusion, Mr. Little emphasised the importance of creating an interest in research problems in the mind of the manufacturer and the public.

PIUTTI, in 1886, pointed out that while *d*-asparagine is sweet, its stereo-isomer, *l*-asparagine, is tasteless. This was the first observation indicating the nature of the connection which may exist between the flavour and the molecular structure or configuration of an organic compound. Since that time a large number of records have been made as to the effect which changes in chemical composition or molecular arrangement bring about in the flavour of organic substances. Thus *d*-leucine and *d*-phenylalanine have been found to be sweetish, whilst their *laevo*-isomers are bitter; and of the anisaldoximes the one with the *anti*-configuration is very sweet, whereas the *syn*-aldoxime is tasteless. The monohydric alcohols are only slightly sweetish, but with increase of the number of hydroxyl groups, as in the glycols, glycerols, etc., the sweetness becomes very marked. On the other hand, the strong sweet taste of "saccharin" is destroyed by relatively slight molecular transformations, such as the replacement of an imide hydrogen atom by a methyl or ethyl group. In the *Revue Scientifique* for December 7, 1918, MM. Barral and Ranc give an interesting summary, ten pages in length, describing the present state of knowledge respecting what may be called the chemistry of sweet flavours. In fine, the known facts, they consider, resolve themselves into a series of approximations to generalisations, but there are always exceptions or anomalies. We are, indeed, still very far from being able to establish a general law, such as would enable the flavour of a compound to be deduced when its molecular structure is known.

CRUDE α-trinitrotoluene, the high explosive, is liable to contain small quantities of its β- and γ-isomers. The three substances are very similar in physical properties, and are equally powerful as explosives. Although the α-variety is by no means a sensitive explosive, some accidents have occurred with it which have not been satisfactorily explained, but which have indicated that the substance may sometimes contain a much more sensitive body. It has generally been supposed that the latter is derived from α-trinitrotoluene, but it may equally well be derived from the β- or the γ-isomer. Messrs. Ryan and O'Riordan (Proceedings of the Royal Irish Academy, December) give an account of an investigation which they have carried out in order to elucidate this question. In the course of their work they found that a sample of crude γ-trinitrotoluene contained a dark, amorphous substance which explodes on heating; this, they think, may be of considerable interest in connection with the explanation of the accidents mentioned.

DR. SIDNEY RUSS suggests a new X-ray unit in radiotherapy. The unit, termed a "rad," is based on the amount of radium which, when applied to malignant tumour cells, causes complete inhibition of their power to grow after an exposure for one hour; this is determined by tests on rat-cancer. For measuring the dose of X-rays administered to a patient, the photographic action of the rays is obtained on a photographic plate, and upon the same plate is impressed the photographic action of the standard radium. The plate is developed and a comparison made between the photographic impressions so obtained. For example, if the X-ray tint for an exposure of ten seconds equalled that obtained with an exposure of six seconds with the radium, the dose of X-rays during the ten seconds' exposure would be 1/600 rad (*Archives of Radiology and Electrotherapy*, No. 221, December, 1918, p. 226).

THE launch of the first large self-propelled seagoing reinforced-concrete vessel to be built in Great Britain—the *Armistice*—took place at the Ferro-Concrete Ship Construction Co.'s yard at Barrow-in-Furness on January 7, and forms the subject of an illustrated article in *Engineering* for January 10. The ship is of 205 ft. length between perpendiculars, 32 ft. moulded breadth, 19 ft. 6 in. moulded depth, and is to have a speed of about $7\frac{3}{4}$ knots with 400 indicated h.p. Trisec steel bars having a very high tensile strength were used for the reinforcement. The concrete was made up of a granite aggregate, sand, and British standard specification cement. The sand used was a mixture of coarse and fine grains, from $\frac{1}{8}$ in. downwards; the aggregate consisted of granite chippings of assorted sizes, not less than $\frac{1}{8}$ in. and not more than $\frac{1}{2}$ in. Fresh water was used exclusively for mixing up the concrete. The method used in construction was to build a box round the reinforcement bars, into which the concrete was poured and rammed hard. To reduce the quantity of timber employed a system of steel sheets, suitably stiffened, was used as shutters. The machinery consists of two cylindrical boilers 9 ft. 6 in. in diameter by 9 ft. long, to work at 140 lb. per sq. in. The engines are of the compound surface condensing type, having cylinders $15\frac{1}{2}$ in. and 33 in. in diameter by 24 in. stroke.

IN the *Times* of January 14 there appears an interesting account of the surrendered German ships by a member of the Allied Naval Commission in German waters. The good German shooting is attributed more to superior range-finders and training than to the gunnery control system. The statement that the German ships unquestionably had more accurate range-finders than the British is not accepted by many of those in possession of the facts. It is generally agreed that the first German salvoes were excellent, but not necessarily better than the British, and that, whereas the British fire continued good, the German fire became erratic when the ships were hit. The primary function of a Service range-finder is to provide ranges when in action. It is essential that it should keep in adjustment under battle conditions. To save the reputation of the German range-finder it is necessary to attribute the failure to a peculiar human moral weakness, which, however, was certainly not in evidence throughout the war. As the result of the Battle of Jutland the superiority of British fire was recognised by the Germans, whose later conduct is some proof of this. The superiority of British range-finders was known to the German Government, which in 1914 approached British makers with regard to the supply of their instruments. During repeated competitive trials by the French Government the German range-finders were invariably beaten by the British. This defeat the Germans explained on political grounds, but as the result of extensive trials in Austria-Hungary British instruments were adopted throughout the Austro-Hungarian Navy and largely throughout the Army. These British range-finders which have defeated the German product in so many lands have optical parts made of British glass. No German glass is used, and during the war a considerable amount of excellent optical glass has been made by the range-finder manufacturers themselves.

MR. JOHN MURRAY'S new list of announcements contains the following forthcoming books:—"Travels in Egypt and Mesopotamia in Search of Antiquities, 1886–1913," Dr. E. A. Wallis Budge, 2 vols., illustrated, in which is given the story of the author's missions to Egypt, the Great Oasis, and Mesopotamia, the results of his excavations at Acevân and Nineveh and Dêr in Babylonia, and particulars of the excavations in Assyria and Babylonia from 1782 to 1913; a new and revised edition of "Heredity," Prof. J. Arthur Thomson, illustrated; "The Adventure of Life," Major R. W. McKenna, R.A.M.C., dealing with the question of the origin of life, and showing that, in the development of higher forms and the "survival of the fittest," intelligence, and not brute strength, has been the dominating factor; and "Hints to Farm Pupils," by E. Walford Lloyd, the aim of which is to put in concise terms the most important features of farming which a pupil must master. The volume will contain a seasonal "Calendar of Farm Work."

OUR ASTRONOMICAL COLUMN.

THE COMET 1786 II.—This comet is of interest as being the first of the eight comets discovered by Miss Caroline Herschel. It was observed for eighty-two days, being visible to the naked eye for a fortnight. The observers were Maskelyne (Greenwich), Wollaston (Chislehurst), Méchain and Messier (Paris), and Reggio and Cesaris (Milan). Miss Margaret Palmer, who has made a re-investigation of the orbit (*Astr. Journ.*, No. 744), finds the following ellipse as the most probable orbit:—

$$T = 1786 \text{ July } 7{\cdot}91859 \text{ Berlin M.T.}$$

$$\left.\begin{array}{l}\omega = 324^\circ\ 57'\ 59{\cdot}23''\\ \Omega = 194^\circ\ 27'\ 11{\cdot}37''\\ i = 50^\circ\ 55'\ 5{\cdot}97''\end{array}\right\}1786{\cdot}0$$

$$\log q = 9{\cdot}6128774$$

$$\log e = 9{\cdot}9995992$$

$$\text{Period} = 9373 \text{ years.}$$

The observations are fairly satisfied by orbits ranging from an ellipse with period 3300 years to a parabola. Perturbations by Mercury, Venus, the earth, and Jupiter have been applied.

PARALLAX OF THE BARNARD STAR.—*Astr. Nach.* (No. 4971) contains a determination of the parallax of this star, made by photography at Pulkova by Dr. S. Kostinsky. He finds $0{\cdot}622'' \pm 0{\cdot}022''$, a larger value than those found in America, which group themselves about $0{\cdot}53''$. He gives for the proper motion in R.A. $-0{\cdot}0438$s., in decl. $+10{\cdot}249''$. Place at epoch 1917·473 17h. 53m. 46·456s., $+4^\circ\ 27'\ 57{\cdot}28''$ (equinox of 1917·0). Photographic magnitude, 10·6; photovisual (with yellow filter), 9·4.

THE BRITISH SCIENCE GUILD AND ITS EXHIBITIONS.

AT a dinner given at Princes' Restaurant on January 15 several speeches were made concerning the results of the British Scientific Products Exhibition held by the British Science Guild in August and September last, and also the work of the guild for the advancement of science and its application to industry.

The Marquess of Crewe, president of the exhibition committee, was in the chair. After the usual loyal toasts he proposed "The British Science Guild," alluding to the valuable educational work which it had conducted since its foundation in 1905. The war had brought home to everyone the value of scientific method and knowledge, not only as a weapon in war, but also in industry and education. In these respects our adversary Germany had truly eaten of the tree of knowledge, but that fruit had turned to poison because of the spirit in which it was eaten. Our task must be to dissociate science from this disastrous spirit, to show that the proper applications of science, pursued with reverence and humanity, added immensely to the happiness of mankind. The guild had pursued two main objects, which were, however, closely related. It desired, first, to secure fuller attention to science in the general education of youth. While a sound general education was necessary as a preliminary to technical specialisation, this general education should contain a fair proportion of scientific studies. The second object of the guild was to promote the higher branches of scientific research and to encourage their application to industry. As the Minister who brought into being the Department of Scientific and Industrial Research, he observed with pleasure the closer relations being established between science and industry and the growing recognition of the benefits of industrial research—results which were due, in a large measure, to the influence of the British Science Guild. The exhibition had proved a wonderful revelation of the possibilities of science. He hoped that it would be a permanent feature in the industrial life of the country, and that in future the guild would continue to flourish and play its part in the advancement of learning and science.

Lord Sydenham, who replied on behalf of the British Science Guild, referred to some of the difficulties encountered at the outbreak of war. For a long time we were dependent upon improvisation for articles urgently needed by the Army, Navy, and Air Service, and it was due to the efforts of British men of science that these needs had been met. Lord Sydenham proceeded to mention various instances of discoveries made in this country but afterwards developed abroad. Perkin's discoveries in relation to dyes furnished a well-known example. Helium gas was first discovered in the sun by Sir Norman Lockyer, and twenty-six years later was identified on the earth by the late Sir William Ramsay, these two distinguished men being the founders of the guild. The Americans are now producing it in large quantities as a non-inflammable gas for the inflation of airships. The British Science Guild aimed at the co-ordination of science, education, and industry. The British Scientific Products Exhibition had shown what British men of science could do. Another exhibition on a larger scale was planned for the present year. In the difficult reconstruction period science and scientific methods of direction in the Government could do a great deal to recreate national prosperity and provide happier and healthier conditions of life.

Mr. F. G. Kellaway, M.P., Parliamentary Secretary, Ministry of Munitions, in proposing "The Exhibitions of 1918 and 1919," said that events during the war had aptly illustrated the romance of applied science. Experience belied the idea that John Bull was a sluggish and lethargic person. It would be fitter to apply the description uttered by Milton two hundred and fifty years ago: "A nation that is not slow and dull, but a quick, ingenious, searching spirit, acute at invention." In proof of this he would mention two inventions relating to defence against hostile aircraft. One of these was the simple and ingenious sound-ranging apparatus that had enabled searchlights to pick up, almost invariably, enemy machines over London. The secret of the other device was still locked up in the Ministry of Munitions, but the weapon was so powerful that hostile aircraft could not face it. Both these inventions were mainly due to men whose names were unknown to the general public. Mr. Kellaway also quoted facts to show how British manufacturers, aided by science, had met the sudden demands of the war. Sixty per cent. of the world's stores of mica, a material essential in the electrical industry, were located within the British Empire, yet before the war 50 per cent. was sent to Germany for treatment. Now things were very different. Similarly, we had formerly to go to Germany for magnetos and ignition plugs, yet to-day the British magnetos and plugs were the best in the world, and the output of these two articles had risen enormously during the war. It was the task of the British Scientific Products Exhibition to make such facts known and to encourage similar advances in the future.

This toast was responded to by Sir Robert Hadfield, who supplemented the remarks of the last speaker by referring to some of the achievements of the iron and steel industry. The biggest shell used in the war, 18 in. in diameter and weighing $1\frac{1}{4}$ tons, was produced in this country. It was capable of penetrating armour-plate 41 in. thick; at a range of ten miles it would still penetrate 22 in., and at twenty miles $12\frac{1}{2}$ in. of armour-plate. We should not, however, follow Germany in using science as a weapon of aggression, but would, as the chairman said, apply it for peaceful ends in the spirit of reverence and humanity. Sir Robert proceeded to give some facts showing the success of the British Scientific Products Exhibition, which had attracted more than 30,000 visitors in London and 15,000 in Manchester—more than 45,000 in all. This year they hoped to make the exhibition much wider in scope. He wished to thank all who had contributed to the success of the exhibition in 1918, and referred especially to the services of the chairman of the organising committee, Prof. R. A. Gregory, and the secretary, Mr. F. S. Spiers.

The toast of "The Donors of the Exhibition Fund" was proposed by Mr. Charles F. Higham, M.P., who acted as honorary director of publicity to the exhibition. Mr. Higham explained that the cost of the exhibition had been defrayed from private enterprise, and it had not been assisted by the Government. He wished to express thanks to all those who had given their support, including the original donors (Sir William Mather, Sir Robert Hadfield, and Mr. Robert Mond) and the manufacturers who had responded to the invitation of the organising committee to contribute. Now that the exhibition had proved its worth he hoped many other manufacturers would participate on the next occasion, and that their contributions would be even more generous than in the past year.

Mr. Milne Watson, responding for the donors, emphasised the value of scientific methods of test in improving the quality of products, using as an illustration some experience in the ammonium sulphate industry. Manufacturers must be taught that the perpetuation of mediocre methods was wrong, and that it paid to use every available scientific weapon to secure the finest possible results.

In the absence of Mr. John Hodge, M.P., the toast of "The Chairman" was proposed by Prof. d'Arcy Thompson, the Marquess of Crewe briefly responding. This terminated the proceedings. The dinner was attended by about 150 men of science, manufacturers, and others associated with the exhibition.

EDUCATIONAL CONFERENCES.

THE seventh annual conference of Educational Associations, comprised of thirty-four educational societies, which was numerously attended, was opened at the University College, London, on January 1 and concluded on January 11. The inaugural address, characterised by abundant wit and humour, was delivered by Mr. Fisher, the President of the Board of Education. The conference week included also the annual meetings of the Headmasters' Conference, the Incorporated Association of Headmasters, the Association of Directors and Secretaries of Education, and the Association of Public School Science Masters, some of the proceedings of which have already been reported in NATURE.

At a joint conference of the educational associations held on January 3 an interesting address by Prof. John Adams, who is now in France, was read on "The Utility Motive in Education," in which he urged that pure knowledge often owed its opportunities to the help offered by practical applications, which he illustrated by reference to the strides made by physiology, the progress of which had hitherto been slow, so soon as it became associated with the teaching of students of medicine; to psychology, when education captured it, and it became included in the professional training of teachers; to navigation, which made possible the development of pure astronomy; and, lastly, to the technical demands of dyers and other practical people, which had led to such subsidising of chemistry teaching as had greatly favoured the disinterested study of the subject. Might we not find in all this, he said, some justification for the plea that a working arrangement could be made by means of which a clash might be prevented between the claims of the cultural and the utilitarian ideals? The demands of the practical man might be met, not only without forfeiting the right to carry on disinterested work, but also in a way to favour such work in its proper place. Man was one and indivisible; he must be trained to hold his own in both spheres, utilitarian and cultural. Knowledge that refined a man's character was as useful as knowledge that increased his productive power in a material sense. The swing of the pendulum was at present strongly in favour of the practical, and a hard fight might be necessary to get due attention to the other aspect. But they would certainly not succeed in maintaining a due proportion of the cultural elements if they set out on a crusade for the useless.

Miss Mercier, head of Whitelands College and president of the Training College Association, in delivering her presidential address to the latter, pleaded for a higher type of education for students training as teachers. The training college might, and should, become also a school of social service. Neither reading alone, nor desire of service alone, made the good teacher, but a blend of both. Students would often benefit by a university course, but some would not be suited to it. There should be large liberty in devising courses. Mr. George Lansbury, who spoke later to the same body upon teaching, urged that the teachers should cultivate a really radical outlook, by which he meant that outlook on life which went to the root of things. Unless there were a tremendous amount of idealism in the teachers, they would not make very much impression upon the children.

At the meeting of the Eugenics Education Society Prof. J. Arthur Thomson, of Aberdeen, gave an address on "The Eugenic Ideal of Education," which he defined as the organic improvement of the human breed, but one which, though primarily a biological ideal, had an horizon far wider than the poultry yard or the breeder's pen. It recognised that it was dealing with a very complex organism, which was at least as much mind-body as body-mind; that the thinking, feeling, willing side of man's constitution was just as real as the throbbing muscle and thrilling nerve. It believed that character was as vital an organismal quality as stature, or weight, or length of life, or fecundity, and they must rid their minds for ever of the prejudice that the eugenic ideal smacked of the farmyard in any objectionable way. There was need for a wider and deeper recognition of the commonplace that young people are organisms—growing, developing, varying, too, if we would let them—serving what should be a joyous apprenticeship to the serious business of life. These children were not only little men and women in the making, but also young mammals—really and truly young mammals. Their health was not incidental—it was well-nigh everything; their motor system was not irrepressible without serious risks; their play was not a luxury, but an essential; their adolescence in the novel, artificial conditions of civilisation needed to be guided sympathetically; their adult functions and environment must be looked forward to and prepared for.

An address was delivered by Lord Gorell, Deputy Director of Staff Duties (Education), to the meeting of the Teachers' Guild on January 2 on "The Education of Men on Military Service," in which he related the steps that had been taken as opportunity served for providing means of instruction and education for men engaged in war service. Lord Gorell stated that there were at the present time at least three million students. The work had risen from below; it had not been in any way put upon the Army from above. The first aim was to give the soldiers some diversion from the stress of war; the second was the high ideal of education, to brighten intelligence and promote self-realisation; and the third was to help definitely in what they intended to do in the future.

Addresses were delivered to the members of the Teachers' Guild on "National and International Ideals on the Teaching of History" by Prof. F. J. C. Hearnshaw, of King's College, and by Miss A. E. Lovett, Vice-President of St. Hilda's Hall, Oxford. The former pleaded that the Spartan sought his ideal man of the type of Leonidas, the Athenian that of Pericles, the Roman that of Cæsar, the medieval schools that of Aquinas; but our present ideal is a communal one. We were seeking to evolve the excellent craftsman or the man of trained mind ready to take up work. Discipline and the sense of duty fitted men and women to play a right part in national life. They needed a knowledge of history which trained the imagination by the pageant of stories, then showed the relation of cause and effect. Later on two sides of a question were perceived, and so impartiality might be learnt. The mind's horizon widened by the study of great men and great careers. Miss Lovett urged in her address that the word "international" should connote added understanding and sympathy. The study of history affected action. Not only must truth be sought, but the question should also be constantly present: Are our ideals and aims for the aggrandisement of our country or for the world's good and the glory of God?

To the members of the Civic and Moral Education League an address on "The Physical and Psychological Bases of Education" was given by Dr. Eric Pritchard, in which he claimed that the same principles which led to good physical development applied to the making of good moral character. In describing at some length the nervous and cerebral mechanism of the formation of habit, he said that many disturbances, such as bad circulation, were, in fact, a kind of bad habit of the system. The first impression made on the tabula rasa of the virgin nerve-cell was of paramount importance. He had traced back chronic nervous coughs to over-stimulation of the respiratory apparatus at birth. The suggestive power of home environment often counteracted the work of the school. So bad was the influence of many homes in great industrial centres, and so strongly did he believe in the educational influence of the home, that he would almost be willing to see the homes of this country sacrificed for a generation if the bringing up of these expatriated children in orderly, disciplined institutions would provide a race of parents capable of making proper homes for the next generation. Dr. Constance Long, dealing with the same subject, said that character was the perpetual acquisition of something that was at all times incomplete, and its first requisite was that it should be capable of growth. National action was individual action multiplied a thousandfold, and to understand an individual it was necessary to study, not only his conscious, but also his unconscious mind. The psycho-analytic view forced us to realise that the unconscious side of the mind played a far larger part in our actions than was generally supposed.

Memorable addresses were delivered in various sections of the conference on art and its applications, on manual training and hand-work, on Nature-study, and on other subjects of deep interest to teachers. The various audiences had the advantage of inspecting a splendid exhibition of books, maps, wall-illustrations, and a variety of school apparatus. Such conferences at this critical time cannot fail to be of supreme value in widening the aims and strengthening the purposes of all engaged in the work of education.

At the annual meeting of the Association of Directors and Secretaries of Education, held in the County Hall, Westminster, on January 6, the newly appointed chairman, Mr. W. A. Brockington, Director of Education for Leicestershire, delivered an inspiring address in which he dwelt upon the vital significance of the Education Act of 1918, which he characterised as the realisation of a dream rather than as the development of a system—a phrase which would well describe the Acts of 1870 and 1902 with all their attendant statutes. The mind of the nation was open to receive new and enlarged ideas, and better educated than in 1870 and 1902; hence the Bill came into being at a happy moment. The administrative officers of education throughout the country welcomed the Act, since it realised in so large a measure the aims they sought, which were that the schemes of the local education authorities should embrace not only elementary, but also all other forms of education included in their jurisdiction, proportionate block grants, the control of laggard or recalcitrant authorities, the abolition of differential rating, the declaration of higher education as a duty, and the consequent removal of the rate limit in county areas; and, on the social side, the universal raising of the compulsory school age, the provision of adequate maintenance scholarships so that no capable child shall be debarred by poverty from the fullest educational facilities, the establishment of day continuation schools for those in employment between fourteen and eighteen, together with full freedom of organisation according to local conditions, the provision of full-time advanced schools of varied type, the restriction of child-labour, the adequate provision of physical training, medical inspection and treatment, and, lastly, the endowment of scientific and industrial research. It is a matter for much rejoicing that these aims have found expression under the guidance of a master-pilot in an Education Act. But the realisation of its provisions are beset with many and peculiar difficulties which will require much patience, great courage, untiring effort, and a fine spirit of sacrifice on the part of the community to realise. Yet the reward will be great. There will need to be the closest co-operation among educational authorities to give the requirements of the Act their full effect, and they can only be solved painfully step by step. The supply of suitable teachers is in itself a vast problem, as well as the provision of appropriate buildings. The arrangement of the hours of instruction so as to meet the necessities of the various industries is scarcely less perplexing. In many cases it must be met by taking the whole of a working day or more per week for a limited period, and in rural areas during some weeks of the winter season. Indeed, it will be seen that no greater step was taken during the great war towards peace-time reconstruction, seeing that the Education Act, worked to its logical limit, means reconstruction all round.

THE PRODUCTION OF OIL FROM MINERAL SOURCES.[1]

MANY and very various products can be obtained by the carbonisation of bituminous minerals, the character and quality of the materials produced depending mainly upon the temperature at which the process is conducted. It does not, however, follow that all identical products will be obtained from different bituminous materials when they are subjected to the same temperature conditions, because the chemical composition varies, and consequently when subjected to heat the method of decomposition also varies. The organic body or bodies in shale are called kerogen, and this, on being subjected to moderate heat, yields oil of the olefine and paraffin series, ammonia also being produced. The organic matter in coals and cannels is generally described as volatile matter, and probably differs considerably in chemical character from the kerogen; consequently, on being subjected to moderate heat, different products are obtained, although they also are mainly of the olefine and paraffin series. When coals are subjected to high temperatures a different class of hydrocarbon is produced, mainly the hydrocarbons of the benzene series. It is probable that this would also be the case to a greater or less extent if shale were also subjected to high temperature in retorts similar to those employed for heating coal.

It is extremely difficult to obtain an even distribution of heat in any carbonisation process; consequently it is by no means easy to make certain of always obtaining the same products from a given material in the same proportions, and great care has to be exercised to ensure that the conditions are as nearly constant as possible. The form of the retort has much to do with the quantity and quality of the products obtained. In all cases the first effect of the heat is low-temperature distillation, because the material is introduced cold into the retort, and, however high the temperature of the retort, the heat must first get through the badly conducting mass before the temperatures can approximate to that of the retort, and by that time a considerable part of the volatile matter will have been driven off. Then another question arises, viz. whether the form of the retort is such that the volatile products, as they are formed, come in contact with the surface of the retort before being drawn off, or whether they are removed without being heated after they have been expelled from the material. The quality and character of the final products depend almost entirely upon this. Thus in horizontal gas retorts the volatile matter as it leaves the coal comes in contact with the highly heated arch and sides of the retort before it enters the ascension pipes and is carried to the hydraulic main. This causes radical changes in the volatile products, and hydrocarbons of the benzenoid or aromatic series are largely produced. On the other hand, in a vertical retort the volatile products, as they are released from the coal, ascend upwards through the cold incoming coal, only a portion coming in contact with the hot walls of the retort, and, as a consequence, the resulting products contain a considerable proportion of hydrocarbons of a paraffinoid nature.

Whether high or low temperature should be employed for carbonising bituminous material entirely depends upon what products are required. For gasworks, where a large-volume yield of gas is required, high temperature is essential, but where motor spirit, fuel oil, lubricating oil, and paraffin wax are required, low-temperature carbonisation must be adopted. In low-temperature carbonisation the gas produced is less than half that obtained by high-temperature carbonisation, and contains less hydrogen and more hydrocarbons than the latter; low-temperature carbonisation could, therefore, not be employed for the manufacture of gas for lighting purposes. The main distinctions between high and low temperature are as follows:—

High Temperature.	*Low Temperature.*
(*a*) Large volume of gas, say 12,000 cu. ft. on the average.	Low volume of gas, say 5000 cu. ft. on the average.
(*b*) Yield of sulphate of ammonia, on average, say, 20 lb.	Yield of sulphate of ammonia, on average, say, 10 lb.
(*c*) Yield of tar on average, say, 11 gallons per ton of coal carbonised.	Yield of tar (crude oil) on average, say, 20 gallons per ton of coal carbonised.
(*d*) Tar is largely of aromatic series, and yields benzol, toluol, naphthalene, anthracene, carbolic acid, and cresols. These are the raw products for the manufacture of dyes, explosives, photographic chemicals, drugs, and many other synthetic products.	Tar (crude oil) consists of hydrocarbons of the aliphatic series (paraffins, olefines, and naphthenes). From the tar can be obtained motor spirit, fuel oil, lubricating oil, and paraffin wax. The tar acids are useful for disinfectants, but of no use as raw products for other industrial purposes.

It should be mentioned that when coals high in volatile elements and rich cannels are subjected to low-temperature distillation, much larger yields of crude oil are obtained, as much as 40 and 60 gallons.

Oils obtained by the carbonisation of bituminous material come under the same category as natural oils; they may, therefore, be classed as mineral oils, even although their origin was probably organic, as was that of natural oils, but many organic substances, such, for example, as peat or wood, will give oils of a similar character when carbonised under suitable conditions.

At the outbreak of the war the world's production of natural oil was in the neighbourhood of 50,000,000 tons, and last year more than 60,000,000 tons.

Before the war Great Britain was, with the exception of the oil obtained from the Scottish shale-oil industry (275,000 tons crude oil), entirely dependent upon imported oil for all the various purposes for which oil is required. Our aeroplanes, warships, motor-cars, etc., were dependent upon sea transport for petrol and fuel oil, and our machinery for lubricants. Unfortunately, we are still in the same position. Great Britain, with her vast Navy and her great

[1] Abstract of a paper read before the Institution of Petroleum Technologists on December 17, 1918, by Dr. F. Mollwo Perkin.

fleet of aeroplanes, is dependent for fuel upon sea-borne transport, and this should not be necessary, or, at any rate, only in a partial degree. In the future our merchant ships will probably burn oil fuel. We have at hand mineral resources from which we can produce mineral oils—petrol, fuel oil, lubricating oils, and paraffin wax. Why do we not employ them? There are, of course, many difficulties in founding a new industry, and one of the greatest difficulties has been Government action or inaction. There is now, however, a stirring among the "dry bones"; a great deal of experimental work has been carried out, much of it on semi-commercial plant, and there are now several large schemes under consideration, which would involve the putting up of an extensive plant both for retorting and refining the oil and to obtain power from the residuals or domestic fuel.

The ordinary shale retort is not adapted for dealing with caking bituminous material, or, indeed, for treating cannel and non-caking coals; hence the larger amount of research work which has been carried out in the endeavour to devise a suitable retort for dealing with bituminous materials which contain a large amount of fixed carbon, and will yield, after extraction of the volatile matter, a good fuel for domestic purposes. It might be replied: "But this is already obtained in the gasworks, where, when coal is carbonised to produce gas, a residue of from 68 to 70 per cent. remains in the form of coke, besides which tar and ammonia are produced." True, coke is produced, and this coke contains a very low percentage of volatile matter, and for this reason is not adapted for burning in the ordinary grate. Coke produced by low-temperature carbonisation (350°–550° C.) is softer than that produced at high temperatures (above 900° C.), and usually contains from 7 to 11 per cent. of volatile matter. The presence of this volatile matter causes the coke to burn readily, practically without flame or smoke, and to give out a great heat. It is, consequently, very clean for household purposes, and if it were used instead of coal the cost for the painting and decoration of the house would be considerably reduced. Furthermore, the atmospheres of our large towns and cities would be very much less contaminated by smoke, and the living conditions would be healthier.

In producing this smokeless fuel by low-temperature carbonisation there is produced at the same time oils of the aliphatic series, which on refining yield motor spirit, fuel oil for internal-combustion engines or for direct boiler firing, lubricating oils, and paraffin wax, besides which there is a small quantity of ammonia and sufficient gas to fire the retorts and leave a small surplus.

Now in low-temperature practice there are three possibilities, any of which might be a financial success, or they might be combined:—

(1) The production of oil and smokeless fuel.

(2) The production of oil and the conversion of the fuel residue into power-gas by gasifying it in a producer.

(3) The production of oil, using a portion of the fuel for domestic purposes and gassifying the remainder.

In districts where power is not required for manufacturing purposes, but where coal or cannel could readily be obtained without having to transport it for long distances, then the first proposition would be the one to embark on.

On the other hand, where cheap power in large bulk is required, then (2) would be the process to take up. Probably in all cases a certain proportion of the residue would be sold as smokeless fuel.

Those who do not know the quality of the low-temperature products have said: "We shall then be able to win back the dye industry from Germany." We nearly lost the war to Germany from lack of oil. Lord Curzon recently told us that at one time there was a stock of only 900,000 tons in the country against a minimum of 1,500,000 tons which the Admiralty considered necessary. The Fleet, in fact, had to restrict its exercises in order that, if a battle took place, there should be sufficient oil to go round. When we know more of the internal management of Germany during the war, it will doubtless be found that the Germans produced large quantities of oil by low-temperature carbonisation of bituminous material. They were doing so before the war.

One of the reasons why low-temperature carbonisation has, so to say, hung fire is due to the exaggerated claims made by inventors, backed up by company promoters. In all distillations of bituminous material water is obtained along with the oil, and is at times extremely difficult to separate, as the specific gravity of the crude oil approximates to that of water. In fact, it is not unusual to find 30 to 40 per cent. of water in the crude oil. This has all been lumped in as oil, hence the impossible claims for oil yields which have been made.

The days of exaggeration are, it is to be hoped, past, and careful research has taken the place of romance. If the claims are more moderate, at any rate we are working on a sure foundation, and many of us believe that a home oil industry can be founded on business lines, which, although not rendering us self-supporting, will, at any rate, supply a portion of our needs and tend to prevent exploitation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A new educational office has been established by the council of St. John's College, with a view to the co-ordination of the college teaching in natural science subjects and the special encouragement and direction of scientific research. Dr. W. H. R. Rivers, fellow of the college, has been appointed to this office, with the title of prælector in natural sciences. Mr. R. Whiddington, fellow of the college, has been appointed to the office of director of studies in physics.

The compulsory Greek in the Previous Examination was abolished by vote of the Senate on January 17. By a very large majority (161 to 15) the Senate approved a report of the Previous Examination Syndicate containing the recommendation that Greek should be made an optional subject. Although the final plans for the reconstitution of the examination are not complete, since the details of parts ii. and iii., which it is proposed shall consist of papers in mathematics, science, and English subjects, are still under consideration, the question of compulsory Greek was regarded as being so urgent that the proposals for part i. were submitted to the Senate without further delay. In consequence of the approval of this report, a candidate, after January 1, 1919, is allowed to take as an alternative to the old classical part i. of the Previous Examination a new part i., in which Latin is compulsory, but Greek is made alternative to French, German, Italian, or Spanish. The "additional subjects," which hitherto have had to be taken by candidates for an honours degree, are abolished.

Men who have been engaged on military service are now coming up to the University in large numbers, and lecture-rooms and laboratories have begun to resume something of their pre-war aspect. Four terms are allowed to men who have been on war service for not less than six months, whether they have previously joined a college or not, and they are exempted either from the previous or from one special examination. Those who have served for shorter periods may also be granted certain exemptions.

At the end of January four hundred naval lieutenants and sub-lieutenants are coming to Cambridge for a six months' course. These are men who were promoted from the rank of midshipman during the war before completing their normal preliminary course of study. They will be distributed among several colleges, and will be under naval discipline. The University will provide instruction for them in physics and engineering, and, in addition, courses in various optional subjects, literary as well as scientific, are being arranged.

A COMMERCIAL library, established by the subscriptions of local business men, was opened in Dundee on January 17 by Sir Alfred Ewing, principal of the University of Edinburgh.

THE Edinburgh University Court has approved the scheme for the founding of a chair of mental diseases, submitted by the board of the Royal Edinburgh Asylum for the Insane, which has offered an endowment of 10,000*l.* towards the salary.

SIR JOHN HERKLESS, principal of St. Andrews University, announced that Mr. George Bonar, president of the Dundee Chamber of Commerce, has given 25,000*l.* to establish a scheme of commercial education in connection with University College, Dundee. One of the conditions of the gift is that a degree of Bachelor of Commerce should be established, and that university students seeking that degree should not be compelled to pass a preliminary examination or to have come from higher or secondary schools, but that boys or youths who present themselves should be admitted if they are able to show that they are capable of improvement and of undertaking university study.

SOME years ago Prof. MacGregor, of Edinburgh University, with the help of a committee of the late Prof. Tait's friends and former students, launched a scheme for establishing a Tait memorial chair in mathematical physics and applied mathematics. Considerable progress in collecting funds had been made, but Prof. MacGregor's death and the advent of the war prevented the scheme being proceeded with. Recently, however, the committee, with the cordial support of the University authorities, has resolved to make a general appeal for funds towards the endowment of the proposed chair. About 15,000*l.* will be required. In connection with this movement an anonymous donor has placed in the hands of the University Court for a certain number of years an investment yielding yearly a considerable interest to accumulate as part of the endowment of the Tait chair of mathematical physics. The Tait memorial committee will welcome similar contributions, which may be intimated to the general secretary of the Royal Society of Edinburgh, who acts as hon. secretary of the committee.

WE learn from *Science* that the will of Capt. J. R. De Lamar, mineowner and director, leaves nearly half of his estate, estimated at 4,000,000*l.*, to the Harvard University Medical School, Johns Hopkins University, and the College of Physicians and Surgeons of Columbia University for medical research. The bequests to these institutions in equal shares consist of his residuary estate, estimated at about 2,000,000*l.* He gave a trust fund of 2,000,000*l.* to his only child, Alice A. De Lamar, with the provision that if she dies without issue the principal of this fund also goes to the institutions named. The will requests that this fund be used "for the study and teaching of the origin of human disease and the prevention thereof; for the study and teaching of dietetics and of the effect of different food and diets on the human system, and how to conserve health by proper food and diet." The money is to be used to establish fellowships, scholarships, and professorships; to provide laboratories, clinics, dispensaries, and other places for study and research; and to publish the results of such research, not only in scientific journals, but also by popular publications and public lectures.

IT was pointed out by Sir J. J. Thomson in his presidential address to the Royal Society in 1917 that much public good might be done by the publication of a popular periodical in which all aspects of progressive knowledge are presented simply and accurately for general readers. Few articles of this type appear in the magazines; and the daily Press is naturally more concerned with subjects of topical interest than with descriptive accounts of the state of knowledge of any particular subject, however stimulating such surveys may be in style or substance. It is believed that teachers would welcome a periodical which would give them at least a glimpse of what is being accomplished in many developing fields of knowledge—scientific or otherwise—and that the extended views thus obtained would often put new life into the body of instruction. To consider proposals for the foundation of a periodical with this intention, a conference was held recently, with the Rev. Dr. Temple in the chair, in the rooms of the Royal Society, at which representatives were present of twenty associations, including the Conjoint Board of Scientific Societies, the Classical, English, Geographical, Public School Science Masters', Historical, Modern Language, Library, and Workers' Educational Associations, Royal Society of Literature, National Home Reading Union, and the chief professional associations of teachers. It was resolved by the conference that "it would be to the national interest if a journal could be established which would represent the growth of the chief branches of knowledge in popular form." An executive committee was appointed to draw up a scheme for the management of the journal, and therefore to secure whatever assistance is possible, by the selection of suitable contributors or guarantees of subscriptions, from the bodies represented at the conference. Should the scheme take practical shape, the proposed journal would stimulate public interest in learning of all kinds, and would thus be a valuable aid in changing the attitude of indifference commonly displayed towards intellectual endeavour in this country.

SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, January 14.—Mr. W. Barlow, past-president, in the chair.—A. **Hutchinson**: Stereoscopic lantern-slides of crystal pictures. The twin pictures are projected by means of a double lantern through screens of complementary tints—red and green—and are viewed through similarly tinted screens, one for each eye. If the adjustment is correct, a black-and-white picture stands out in relief. This method admits of the properties of crystals and of crystal-structure being demonstrated simultaneously to a large number of students.—L. J. **Spencer**: Mineralogical characters of turite (=turgite) and some other iron-ores from Nova Scotia. The mineral collection of the late Dr. H. S. Poole, which was presented to the British Museum in 1917, contains, amongst the iron-ores, specimens of magnetite, hæmatite, turite, goethite, limonite, chalybite, mesitite, and ankerite from many well-defined localities in Nova Scotia. The dehydration curves and optical characters of turite ($2Fe_2O_3,H_2O$), goethite (Fe_2O_3,H_2O), and limonite ($2Fe_2O_3,3H_2O$) prove that these, at least amongst the large group of ferric hydroxide minerals, are distinct species with crystalline structure; some others are colloidal. Turite (=turgite, an incorrect German transliteration from the Russian) is a hard, lustrous, black mineral, with a radially fibrous and concentric, shelly structure, and gives a dark cherry-red streak; the fibres are optically birefringent and strongly pleochroic. Sharp, brilliant crystals with the forms of goethite, but consisting of anhydrous ferric oxide, *i.e.* pseudomorphs of hæmatite after goethite, were described.

Royal Meteorological Society, January 15.—Sir Napier Shaw, president, in the chair.—Sir Napier **Shaw**: Presidential address: Meteorology—the society and its fellows. Sir Napier Shaw referred to the change in the position of meteorological work during the war from that of a subject of curiosity, which might safely be left to take its chance with such facilities as were left to the ordinary public by inexperienced censors and controllers, to that of a matter of such importance in gunnery and navigation of the sea and air that all reference to it was rigorously excluded from the newspapers, and a number of special services were improvised to meet the need for meteorological information for our own Forces, acting in co-operation with corresponding organisations for the French, American, and Italian Forces. To meet the demand for information about the fundamental principles and practice of the modern science, necessary for those who were called upon to take up technical duties with very limited training, the Meteorological Office had issued a number of books specially written for the purpose. Looking forward, he said that the immediate necessity was the organisation of the meteorological services to satisfy the demands of the home countries and meet possible requirements of the Dominions beyond the seas. The essential conditions of the organisation were, first, that there should be a career for men of ability, and, secondly, that there should be opportunity for suitable preparation by preliminary training in scientific studies, including meteorology, at the universities. At the same time efficient organisation of the public service required that the regular collection of information about the weather should be placed on a proper footing by arrangement between the central authority and local authorities. The duty which the society should discharge in the changed conditions was to foster or create an atmosphere which would make a satisfactory national organisation on those lines possible by the interchange of ideas and the discussion of meteorological subjects.

Mathematical Society, January 16.—Mr. J. E. Campbell, president, in the chair.—Prof. **Fréchet**: The differential of functional operations.—L. J. **Mordell**: The value of a definite integral.—Dr. T. J. I'A. **Bromwich**: Operational solutions in conduction of heat.

MANCHESTER.

Literary and Philosophical Society, December 10, 1918.—Mr. W. Thomson, president, in the chair.—Margaret W. **Fishenden**: The efficiency of domestic fires and the effects of certain "coal-saving" preparations. The experiments included determinations of (1) the "radiant efficiency," or the percentage of the total calorific value of the coal burned, which entered the room as radiation; (2) the distribution of radiation; (3) the volume of air passing through the room; (4) the amount of heat passing away above the ceiling level in the hot flue gases; and (5) the heating of the room air. Three different grates gave radiant efficiencies of 21, 24½, and 24 per cent. respectively; the radiant efficiency was not dependent upon the draught, even over such wide limits as from one to nine changes of air per hour. The maximum intensity of radiation was found (upwards) at an angle of about 60° to the horizontal through the centre of the fire. The amount of heat contained in the hot flue gases passing up the flue above the ceiling varied from about 55 per cent. of the total calorific value of the fuel burned for draughts of about 20,000 cubic ft. per hour (nine changes), to about 15 per cent. for one change per hour. The heat used in warming the room air was very small, generally below 10 per cent. Certain advertised preparations, solutions of which were claimed, when previously sprayed upon the coal, greatly to increase the efficiency of fires, had been analysed and found to consist chiefly of common salt. Their use was found to have no effect whatever upon the radiant efficiency, the duration of burning, or the rise of air temperature produced by coal-fires.

January 7.—Mr. W. Thomson, president, in the chair.—Sir E. **Rutherford**: The work and influence of Joule. Attention was confined to the first five years (1838–43) of Joule's scientific career, which began at the age of nineteen, and an endeavour was made to trace during this period the gradual growth of Joule's power of experimentation and of philosophic insight. This period was, in some respects, the most fruitful and inspiring in Joule's lifetime, for it included his remarkable researches on the transformations of energy in the voltaic cell, the dynamo and motor, and his first measurement of the mechanical equivalent of heat. A brief discussion was given of the reasons why the full recognition of the fundamental importance of Joule's earlier researches was so long delayed and of the difficulties experienced by Lord Kelvin in reconciling Joule's conclusions with the work of Carnot on "Heat Engines." Adjustment of views on both sides was necessary before the foundations of the new science of thermodynamics were securely laid, and before the great principle of the conservation of energy was generally recognised.

PARIS.

Academy of Sciences, December 30, 1918.—M. Léon Guignard in the chair.—**Albert, Prince of Monaco**: The course of the floating mines in the North Atlantic and the Arctic Ocean during and after the war. Experiments on the ocean currents have been carried out over a series of years, a large number of objects made of wood, metal, or glass, and constructed so that they float just below the surface out of the direct action of the wind, being used. The results have been accumulated during twenty years, and can obviously be applied to predict the course of floating mines. The probable track of these is shown on a chart, and the most dangerous localities are summarised as the Bay of Biscay, the west coast of Portugal, Morocco, the Canaries, and Madeira. From the Canaries to the Antilles the path of the mines is wider, and the return to Europe follows the course of the Gulf Stream.—A. **Lameere**: The Dicyemides.—M. **Balland**: The preserved fruit and jam distributed to the troops. An account of the adulterations found in these articles of food as supplied to the French Army.—Sir Almroth Wright was elected a correspondant for the section of medicine and surgery in succession to the late J. Bernstein.—E. **Vessiot**: An integral invariant of hydrodynamics and its application to the theory of general relativity.—L. **Lumière**: A method of recording graphically by means of a jet of gas. It is proposed to replace the style by a very fine capillary. A stream of air carrying ammonia is led through the jet of this capillary tube and impinges on a moistened paper impregnated with mercurous acetate. The movements of the jet, which may replace the needle of a galvanometer, are recorded in black.—A. **Meyer**: Some derivatives of isatin.—P. **Gaubert**: The artificial coloration of liquid crystals. The use of indophenol as a colouring material presents great advantages over substances previously employed. By its means interesting results have been obtained relating to Babinet's rule and to the influence of double refraction on polychroism.—Ph. **Glangeaud**: The volcano of Sancy. Its secondary craters and its lavas.—P. **Lesage**: The utilisation of the curve of limits of germination of seeds after soaking in solutions. If seeds are immersed in alcohol there is a time beyond which the seed will not germinate, and this is a function of the strength of the alcohol. This relation between strength and time has been worked out for the seeds of *Lepidium sativum*. A possible application to the selective removal of the seeds of dodder is suggested.—L. **Lapicque**: The use of marine algæ for feeding horses. The experiments were carried out on *L. flexicaulis*, which were first dried, then washed freely with the addition of a little lime or acid for the removal of mucilage. The horse requires a certain time to get accustomed to the food, about a week, and then digests the algæ completely. For horses doing no work the seaweed can be used in place of oats; for light work, nutritive equilibrium was obtained with 1500 grams of algæ *plus* 500 grams of oats. A horse has eaten 140 kilograms of algæ in ninety-six days without visible inconvenience.—Mlle. Lucienne **Dehorne**: False incubation in *Heteronereis malgremi*.

BOOKS RECEIVED.

Dreams and Primitive Culture. By Dr. W. H. R. Rivers. Pp. 28. (London: Longmans and Co.) 1s.

War and Civilisation. By W. J. Perry. Pp. 27. (London: Longmans and Co.) 1s. 6d. net.

The Philosophy of Mr. B*rtr*nd R*ss*ll. With an Appendix of Leading Passages from Certain Other Works. Edited by P. E. B. Jourdain. Pp. 96. (London: G. Allen and Unwin, Ltd.) 3s. 6d. net.

The Origin and Evolution of Life. By Prof. H. F. Osborn. Pp. xxxi+322. (London: G. Bell and Sons, Ltd.) 25s. net.

A Manual of Elementary Zoology. By L. A. Borradaile. Second edition. Pp. xiv+616. (London: H. Frowde and Hodder and Stoughton.) 16s. net.

Forced Movements, Tropisms, and Animal Conduct. By Dr. J. Loeb. Pp. 209. (Philadelphia and London: J. B. Lippincott Co.) 10s. 6d. net.

Life and Finite Individuality. Two Symposia. Edited for the Aristotelian Society, with an Introduction, by Prof. H. Wildon Carr. Pp. 194. (London: Williams and Norgate.) 6s. net.

A Treatise on Gyrostatics and Rotational Motion: Theory and Applications. By Prof. A. Gray. Pp. xx+530. (London: Macmillan and Co., Ltd.) 42s. net.

A Manual of Geometrical Crystallography: Treating Solely of those Portions of the Subject Useful in the Identification of Minerals. By Prof. G. M. Butler. Pp. viii+155. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7s. net.

A Treatise on the Sun's Radiation and Other Solar Phenomena, in Continuation of the Meteorological Treatise on Atmospheric Circulation and Radiation, 1915. By Prof. F. H. Bigelow. Pp. ix+385. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 23s. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY, at 4.30.—Admiral Sir H. Jackson and Prof. G. B. Bryan: Experiments Demonstrating an Electrical Effect in Vibrating Metals.—Prof. T. H. Havelock: Wave Resistance: Some Cases of Three-dimensional Fluid Motion.—W. S. Abell: Chances of Loss of Merchant Ships.—Prof. W. M. Hicks: A Critical Study of Spectral Series. Part V. The Spectra of the Monatomic Gases.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. P. M. Fleming: Planning a Works Research Organisation.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 5.30.—Temp. Lt.-Col. A. Balfour: One Side of War.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—T. T. Heaton: Electric Welding.—Henry Cave: The Development of the Oxy-acetylene Welding and Cutting Industry in the United States.—J. H. Davies: Oxy-acetylene Welding.—F. Hazledine: Oxy-acetylene Welding.

MONDAY, JANUARY 27.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Commander Spicer Simson, D.S.O., R.N.: The Tanganyika Expedition. (*Duty permitting.*)

TUESDAY, JANUARY 28.

ROYAL INSTITUTION at 3.—Prof. Spenser Wilkinson: Lessons of the War.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Hon. R. C. Parsons: Centrifugal Pumps for Dealing with Liquids containing Solid, Fibrous, and Erosive Matters.

WEDNESDAY, JANUARY 29.

ROYAL SOCIETY OF ARTS, at 4.30.—Dr. F. Keeble: Food Production by Intensive Cultivation.

THURSDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Prof. J. C. McLennan and R. J. Lang: An Investigation of Extreme Ultra-violet Spectra with a Vacuum Grating Spectrograph.—Prof. J. C. McLennan and J. F. T. Young: The Absorption Spectra and the Ionisation Potentials of Calcium, Strontium, and Barium.—Prof. J. C. McLennan, D. S. Ainslie, and D. S. Fuller: Vacuum Arc Spectra of various Elements in the Extreme Ultra-violet.—R. C. Dearle: Emission and Absorption in the Infra-red Spectra of Mercury, Zinc, and Cadmium.—E. Wilson: The Measurement of Magnetic Susceptibilities of Low Order.—Dr. F. Horton and Ann C. Davies: An Experimental Determination of the Ionisation Potential for Electrons in Helium.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 5.30.—Prof. H. H. Turner: Giant Suns.

SATURDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—Prof. H. P. Allen: The Works of J. S. Bach.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

No. 2570, Vol. 102] THURSDAY, JANUARY 30, 1919 [Price Ninepence.

Registered as a Newspaper at the General Post Office.]

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Director of Education.

City Hall, Cardiff

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County Education Offices, Stafford.
January, 1919.

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W. H. OSTLER
Secretary.

Education Offices, Halifax,
January 15, 1919.

CAMBRIDGESHIRE EDUCATION COMMITTEE.

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January 25, 1919.

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January 22, 1919.

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E. SALTER DAVIES,
Director of Education.

January, 1919.

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WANTED at once, CHIEF LECTURER in CHEMISTRY. Day and Evening Classes. Candidates must be graduates of a British University. Salary £250 per annum. Forms of application (which will be supplied on receipt of stamped foolscap envelope) must be forwarded to the undersigned not later than Monday, February 10 next.

GEO. E. FEATHERSTON,
Secretary.

Technical School, Dewsbury,
January 21, 1919.

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THURSDAY, JANUARY 30, 1919.

SCIENCE IN PARLIAMENT.

THE practical absence of leading representatives of scientific knowledge and research in the new Parliament is the subject of an article in the *Times* of January 21. Among the 707 members there are only two Fellows of the Royal Society, Mr. Balfour and Sir Joseph Larmor, neither of whom can be considered specifically to represent science. The work of Parliament is more and more coming to be a sordid scrimmage of hereditary, vested, class, and sectional interests. Out of the base-metal of the various self-seeking coteries represented—agrarian, commercial, financial, professional, proletarian, and so on—by some obscure alchemy too absurd for belief, Westminster is supposed to effect a synthesis of the pure gold of wisdom, and in its odd moments from this conjuring entertainment to administer the affairs of an Empire on which the sun never sets. The helpless public, as in America at its worst, is on the point of abandoning its government to a peculiar people with aptitudes and codes of conduct which in their private life they abhor and despise, and with an intellectual outlook and unteachableness similar to that of the traditional type of public-school legislator whom they have succeeded, but without their reputation for integrity, altruism, and incorruptibility. The practical problem is, How are the learned men—of whose learning and research the twentieth century is, and from whose brains and laboratories arises the necessity for the metamorphosis now blindly and vehemently convulsing it—to pull with something more nearly approximating their true weight *dans cette galère*?

In the article referred to, Members of Parliament are divided into two classes:—First, representatives of the great working-class organisations, the subscriptions of which supply the necessary election funds, and the membership of which gives the necessary electoral backing to secure their return; and, secondly, persons with money and leisure, derived from an inherited or acquired competence, sufficient to enable them to woo an electorate. A third class, numerically perhaps the most important of all, might have been distinguished, the nominees of the party organisations, the election funds of which are derived from origins that are not disclosed, but are generally believed—such is the rottenness of the State of Denmark—to be discreditable in degrees varying from the corrupt sale of honours and peerages to the "legitimate" contributions of powerful sectional interests. The men who devote their lives to scientific studies and investigations, all unintentionally and almost unconsciously rearranging thereby the foundations of society against its will, do not acquire such a competence as election expenses require, and have no mass following in the electorate, who rarely hear their names. Neither are they by intellectual training and character the stuff out of which sound party men, beloved of the caucuses, are made, voting "straight" on the great party issues in return for unconsidered trifles in the way of preferment, influence, and nepotism. They are segregated, to their own and the nation's detriment, from any share in the solution of the vast and overwhelming problems which their activities in the first instance create.

A further difficulty, though one common alike to all doing any work worth doing, whether creative, constructive, or merely vocational, is that a parliamentary career involves, at least for the time being, the sacrifice of their own field of work. This, which may appear to many, at first sight, a consequence fatal to the proper representation of science in Parliament, as a matter of fact is faced daily under existing economic conditions by the scientific investigator in its acutest form. By virtue of his eminence in investigation he is selected for some desirable bread-winning position, and, though he continue by force of habit for a time to strive to retain a footing in his original domain, amid the responsibilities and professional duties his office entails, Nemesis has him, and does it much matter whether it carry him to Westminster or to a university principalship or professorship? Besides, many go willingly enough. Was it not Huxley who said that one of the besetting sins of the investigator was the craving for change and novelty, the turning from the field that has been explored to the fascination of the new? Scores sacrifice their special gifts for causes relatively trivial on the altar of duty to their own microcosm, and why not a few to the primary affairs of the nation?

The practical problem thus in its essentials is twofold: the provision of election expenses, and the provision of the electorate. With regard to the first, the suggestion has been made that the Conjoint Board of Scientific Societies should institute an election fund, as is done by the National Union of Teachers and other bodies, and as, presumably, is contemplated by the medical profession in its recent action to secure more adequate representation in Parliament. Once a line of action is decided upon, the first question can scarcely involve any insuperable difficulty. It is the second that brings us at once to the real practical problem.

In a previous article on this subject (NATURE, October 24, 1918) the issue is clearly raised as between the narrow class representation of science in its own interests in Parliament, and the need of having qualified men of science there as citizens, free to use their special knowledge and qualifications in the national interest as a whole; and the latter ideal is frankly and powerfully upheld. Expert witnesses of a party, or impartial social servants of the community, under which banner are the scientific investigators who are to be asked to sacrifice their life-work to be called upon to serve? If the first, then no one but the type of prospective candidates to whom such work would be congenial, and the scientific organisations likely to benefit materially and directly by their advocacy, will consider the matter worthy of a second thought. Science is, not yet at least, an interest, an organisation, or a profession, but transcends these aspects no less than the welfare of the nation transcends that of the coteries that represent it in Parliament.

There remains the second ideal that men of science should claim their place on the broad and old-fashioned base of impartial and disinterested social service to the nation. If it had not been for the war, to find constituencies for such candidates would doubtless have appeared very Utopian and impracticable. The nation has, however, been brought violently back to its ideals, and that of disinterested social service for the general weal, which the Government demanded of its citizens in war, will in turn be demanded by the nation of its politicians in peace. In a political contest between idealism and materialism almost any sort of idealism is likely to prevail. The wide idealism of the Labour Party has probably gained for it far more adherents than its extreme views and divided war counsels have repelled. Conditions are now fluid, as they never were before, and, when they set, as soon they must, any scheme founded merely on the peculiar standards of to-day's political expediency may find itself nipped at the root. A scheme to send men of science into Parliament to represent in the general scrimmage of interests their own special wants, in return for due allegiance to the party that arranges their election, must reckon with the fervent intention of the overwhelming majority of disinterested electors in this country to prevent in future the rigging of elections, and with the power that proportional representation, already in operation in the university constituencies, gives them to stop it absolutely.

But it is idle to wait until another election is on the country. To have the slightest chance of success, the work should begin now, an election fund should be raised, and a group of prospective scientific candidates got together under a leader of enthusiasm familiar with the inner labyrinth of the political world. With the help of men of goodwill among their own colleagues, the temper of the electorate being what it is and nearly all men of goodwill in the nation awaiting a lead, such a group might find itself in Parliament as soon as, or even before, it was ready to perform its salutary and necessary task in the grave work that lies ahead. But the claim of these candidates to election must rest on the broad and elementary ground that their life-work has given them special knowledge and insight into the scientific discoveries which in the short space of a few generations have revolutionised the whole world, and which the Mother of Parliaments will ignore and continue to run counter to only at the nation's peril.

PHYSICS: ANCIENT AND MODERN.

On the Nature of Things. By Dr. Hugh Woods. Pp. v + 248. (Bristol: John Wright and Sons, Ltd., 1918.) Price 10*s.* 6*d.* net.

The New Science of the Fundamental Physics. By Dr. W. W. Strong. Pp. xi + 107. (Mechanicsburg, Pa.: S.I.E.M. Co., 1918.) Price 1.25 dollars.

(1) DR. WOODS puts forward "a new scientific theory," and asks that his views "shall be carefully considered and supported if they appear true, or attacked if they seem false." He could ask nothing more difficult to grant. Judged by the canons of men of science, his views are certainly incorrect, always when they are new, and sometimes when they are not; his book suggests an essay written by somebody who attended a course of popular lectures at the Royal Institution twenty-five years ago, and afterwards lost his notes.

But, of course, Dr. Woods, though he may not know it, does not accept those canons. He believes, as his title suggests, that truth is to be found in a return to Lucretius. Now the difference between Lucretius and a modern student of science is not so much in what they believe to be true as in what they believe to be truth. Both are concerned to "explain phenomena," and to both explanation consists formally in showing that the observed facts can be deduced from some set of general principles. But if any principles were permissible, anything could be explained without the smallest trouble, for it is very easy to find a set of propositions from which any other set may be deduced. The principles must fulfil some other condition. This condition is that the principles give a certain form of intellectual satisfaction. It is here that we differ from Lucretius and Dr. Woods; the kind of explanation that appeals to us does not appeal to them. *De gustibus non est disputandum.* Of course, we say that the principles which give us the intellectual satisfaction we desire have the advantage over any other set which has been proposed that the explanations based on them often explain facts before, and not merely after, they have been discovered. But the appreciation of that advantage requires a scientific training which Lucretius did not possess.

We do not think, then, that readers of NATURE will gain much benefit from Dr. Woods's treatise. But the existence of such books may suggest some interesting reflections. The differences which separate us from Dr. Woods appear in a lesser degree between students of different sciences, and they are likely to be accentuated by the development of what Dr. Strong (2) rightly calls the "new science" of "fundamental physics." Physicists are abandoning the mechanical explanations, which were the basis of all nineteenth-century science, in favour of those which rest on the acceptance of some formal mathematical principle; and in so doing they are undoubtedly widening the breach between themselves and others. It is not impossible that in a few years the division between physics and chemistry may be as wide as that which now divides either from the philosophy of Dr. Woods and his master.

But, while Dr. Strong's title is encouraging, we regret that we have derived even less edification from his writings than from those of Dr. Woods. Dr. Strong is a serious physicist, and knows his subject, in spite of a few minor errors. (Thus, a "magneton" is not a free pole, but a doublet, and lead is not an "isotrope," but an "isotope," of RaG.) But he has carried compression beyond the bounds of intelligibility; he does not always explain even his notation, or the meaning of his tables. Those of his chapters in which he states the accepted results of modern physics would be perfectly incomprehensible to anyone not already familiar with the subject; no man can possibly expound the subject of radioactivity in four pages. Intercalated among these chapters, apparently at random, are others in which the author expounds some new theory which establishes, by means of "radions" and "electroethons," a connection between the Great Unknown, mobile and immobile ether, the gateways of the senses, ninety-two atomic nuclei, and other familiar and unfamiliar concepts. It may be merely the author's exaggerated passion for brevity which makes these pages a source of nothing but bewilderment to us, for occasionally a suggestive idea gleams through the darkness. We would recommend Dr. Strong first to re-write the chapter, say, on the Ritzian atom, so as to make it intelligible to anyone scientifically educated, and then, having had practice in expression, to return to the statement of his original ideas. We would give him one last hint: grammar is not inconsistent with lucidity, and our language is not enriched by such inventions as "illy" and "hypotheticated."

N. R. C.

APPLIED ANATOMY.

Applied Anatomy: The Construction of the Human Body considered in relation to its Functions, Diseases, and Injuries. By Prof. Gwilym G. Davis. Fifth edition. Pp. x+630. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 30*s*. net.

THIS work is perhaps the most comprehensive treatise upon applied anatomy in the English language. Its outstanding merit is the series of 631 figures, many of them in colour, drawn by Mr. Erwin F. Faber. They are remarkable, not merely for their diagrammatic clearness and accuracy, but also for their pleasing artistic qualities.

The book is cast in a somewhat conventional mould, and gives a vast amount of detailed information of a clinical, as well as of an anatomical, nature. When one remembers how large a part radiography plays in the teaching and practice of anatomy and surgery it is surprising to find a work upon surgical anatomy without any X-ray photographs, especially when the need for assistance in their interpretation is so often experienced by the surgeon. The notes upon the arrangement of the lymphatics might with advantage have been amplified.

But the chief impression one gets from the perusal of this book is the effect of the war upon the surgeon's outlook. For it is scarcely conceivable that so conventional a treatise as this could have been produced in the year 1918 in any country which had had a prolonged experience of military surgery. In dealing with many of the anatomical problems which have daily engaged the attention of our surgeons for more than four years, this book will afford no help. For example, little attempt is made to provide precise information of the mode of distribution and the variability of nerves, such as the majority of our surgeons need for their daily work in these times. It may be urged in extenuation that this book is merely the new edition of a work of reference for civilian surgeons in a country where experience of military injuries had not extended to the home hospitals. But these reflections serve to direct attention to the fact that a book on applied anatomy, when grown to such dimensions as Prof. Davis's treatise, is less useful to the surgeon than an ordinary text-book of systematic anatomy. In the course of practice, whether military or civilian, injury or disease may affect any part of the body; a really useful work of reference, therefore, should provide full information concerning the whole anatomy—in other words, it should be a systematic treatise.

What the surgeon really wants is the information the anatomist can give him; but it is of vital importance that the latter should take a broad view of his functions, and, in writing his text-books or treatises, remember that he is teaching the structure of the living organism, and should provide the sort of information that the surgeon and the physician need. To do this efficiently an intimate association between the work of the anatomical department and the hospital is necessary, not merely to bring the teaching of the former into closer adaptation with the needs of the clinician, but especially to provide the scientific anatomist with the opportunity of investigating such problems as Nature's experiments upon living human beings reveal.

It is essential for the progress not only of anatomy, but also of medicine in the widest sense, that this broader conception of the anatomist's functions should be expressed in practice. One effect of such co-operation of the work of the scientific laboratory with that of the hospital wards would be expressed in systematic anatomical treatises informed by the sort of knowledge the physician and surgeon really need.

Excellent as Prof. Davis's work is, it is impossible to repress the feeling that if the same amount of energy had been devoted to the task by an anatomist who was in touch with the needs of the clinician, a treatise more generally useful to the average practitioner might have been produced. In every branch of applied science what the practitioner needs as the essential equipment for successful work is a real knowledge of the pure science which he has to apply in practice.

G. ELLIOT SMITH.

FRUIT CULTURE.

Modern Fruit Growing. By W. P. Seabrook. Pp. xliii+172. (London: The Lockwood Press (Harvey H. Mason), 1918.) Price 4s. 6d. net.

AT a time when many at present in the Army and Navy are turning their thoughts to fruit culture this manual appears opportunely. The practical advice given will do much to correct the somewhat unduly optimistic ideas as to the profits to be derived from this branch of agriculture, and the careful records of capital required and its subsequent profits are a feature of prime importance.

A chapter is devoted to the various soils on which success may be obtained, and with its general tenor we are entirely in accord. We cannot, however, agree with the opinion that a thin soil on chalk is "practically hopeless," as much good fruit is grown on such land in Kent; in fact, one of the most successful growers of that rather "difficult" apple, Cox's Orange Pippin, possesses soil of this character, about a foot of "loam with flints" on the chalk downs, and in these conditions finds it one of the best-paying crops.

The author is a whole-hearted advocate of the bush-tree on the dwarfing "Paradise" stock, and we think rather under-estimates the value of the standard trees which are grown in the grass orchards, and, in conjunction with sheep-farming, form so large a part of the fruit culture in East Kent. The labour difficulties of the past few years have driven opinion rather against the dwarf plantation with its need for constant cultivation, and experienced growers are interplanting their bush-trees with standards with the view of laying the land down to grass in a few years. For the beginner, however, who must have a quick return for his outlay, the dwarf tree will be always preferred.

Some space is devoted to modern methods of packing which are now spreading, and it will undoubtedly be in this direction that foreign competition will be met in future, rather than the embargo on foreign imports, which the author hopes will be in some measure maintained. The list of profitable varieties given is good, but we regret that the author has included two new sorts as yet untested beyond his own grounds, a matter which may be misleading to the beginner, for whom this work is written. It would be well in a future edition to explain certain technical terms which the same reader cannot be expected to appreciate.

With these reservations the work can be thoroughly recommended.

OUR BOOKSHELF.

The Future Citizen and his Mother. By Dr. Charles Porter, with a Foreword by Sir James Crichton-Browne. Pp. xvi+144. (London: Constable and Co., Ltd., 1918.) Price 3s. 6d. net.

WITH a falling birth-rate and the loss of life occasioned by the great war, the subjects of maternity and child welfare have assumed enhanced importance, and the Chadwick Trustees were well advised to institute a series of lectures on these subjects. Needless to say, Dr. Porter has dealt with the question in an entirely satisfactory manner. In the introductory chapter attention is directed to the falling birth-rate and to the wastage of infant life that goes on. Whereas more than 1,000,000 babies should be provided every year, as a matter of fact only some 800,000 or 900,000 are forthcoming! In the next chapter the care of motherhood is considered. In the worst districts nearly nine, and in the best three or four, mothers die for every 1000 babies born, and it is important to note that maternal death-rate from child-bearing and infant mortality go hand in hand. Valuable suggestions are given for bettering this state of affairs—by the institution of maternity centres and ante-natal clinics, the circulation of instructional leaflets, etc. In the third chapter the infant and infant-mortality, and in the fourth the young child and child-mortality, are discussed at some length. In an appendix specimen leaflets relating to the matters discussed for distribution from infant consultations and by health visitors are reproduced. A number of tables and charts are included, and Sir James Crichton-Browne contributes a characteristic foreword. The book is one which should have a large circulation, and we hope that it will be widely read.

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.*]

Cyclones.

MR. DEELEY'S suggestion (NATURE, January 16, p. 385) that the cyclone is caused by the high temperature of the stratosphere does not seem to me to be feasible for the following reason:—Owing to the temperature inversion, or, at least, to the cessation of the lapse of temperature with height, the boundary between the troposphere and stratosphere is, in general, perfectly definite, as definite almost as the boundary between layers of oil and water would be. If, then, any sort of sucking action—to use an incorrect but convenient expression—were exerted by the lightness of the air above the boundary, it ought to draw up the boundary itself as well as the air below it. This is exactly the reverse of what happens; the boundary bulges out downwards in the cyclone and upwards in the anticyclone.

A special case has just occurred. From January 4 to January 8 the barometer in England S.E. was exceptionally low, and observations on the upper air were obtained on January 6. The beginning of the stratosphere was found at the low height of 7·5 km.—10·7 km. is the average; the temperature of the stratosphere was 10° C. above its average for January, and the troposphere 6° below. Take the analogous case of a layer of oil floating on a layer of water; if a disc of the oil be warmed by any means it will expand outwards, and the same mass will cover a larger surface, with the result that the common horizontal boundary will rise. Conversely, if the oil be cooled, the common boundary will sink. Exactly the opposite result was found on January 6.

But if we postulate an outward radial sucking force acting horizontally on the water just below the common boundary, the water will rise from below at the centre, the common boundary will fall, and the layer of oil above will thicken, and this is just what occurs in the layers of air. I have shown elsewhere (Journal of the Scottish Meteorological Society, 1913, p. 309) that on this supposition the observed changes of temperature follow as a natural corollary, but I do not see how an outward acceleration can be applied horizontally to the layers of air near the top of the troposphere.

W. H. DINES.

Benson, January 17.

WHILE the subject of cyclones is being discussed in NATURE, I should like to direct attention to a point which I have already treated in a paper read before the Royal Society of Edinburgh in January, 1916. It is there pointed out that though the core of a cyclone is colder than the core of an anticyclone or than the surrounding air, yet the air in the cyclone is lighter than that in the anticyclone. This decrease in density is due to the air being under a lower pressure. It is shown that the lower pressure in cyclones more than compensates for their lower temperature, so that though the air in cyclones is colder, yet it is lighter than the surrounding air, and tends to ascend in the troposphere as well as in the stratosphere.

JOHN AITKEN.

Ardenlea, Falkirk, January 17.

End-Products of Thorium.

IN a letter to NATURE of May 24, 1917, Prof. Soddy states that 65 per cent. of thorium-C expels first a β- and then an α-ray, transforming into an isotope of lead, and suggests that (on the analogy of radium-D) this isotope of lead may be further disintegrated. He says that he has detected the presence of thallium in thorite in amounts that sufficed for chemical as well as for spectroscopic identification, and suggests that the lead isotope referred to may be transformed into thallium owing to an α- and β-change. If thallium were an end-product of thorium, we should expect that it would be found in all thorium minerals, unless, of course, these have been sufficiently altered to account for the removal of the products. I have lately been engaged in the examination of thorianite for Prof. Joly, the chief object of the investigation being the determination of the proportion of thallium, if any, and its relation to thorium. I have not been able to detect any thallium in the mineral, and I am confident that it does not contain even 0·005 per cent.

J. R. COTTER.

Iveagh Geological Laboratory,
Trinity College, Dublin, January 8.

COMMERCIAL AVIATION AND THE LARGE AEROPLANE.

THERE is now no doubt that every possible attempt will be made to utilise aviation for commercial purposes, and that one of the first questions to be settled is the choice of the best type of machine for such uses. While small machines of the "scout" type may be of considerable utility for the rapid transport of single passengers or small quantities of goods on special occasions, it seems certain that the representative type of the commercial aeroplane will be a large machine capable of carrying considerable loads.

Several very long flights have already been made with large aeroplanes, and particular mention may be made of Gen. Salmond's pioneer flight from Cairo to Delhi in December last, when a distance of 3200 miles was covered in 45 hours' actual flying-time. In view of such feats as this, it is obvious that the establishment of an effective mail service is well within the capabilities of existing aeroplanes, and merely awaits the necessary capital and organisation. If, however, the air is to be used as a medium for the transport of goods in considerable quantities, machines of much greater carrying capacity than any yet built will be required, and the question at once arises as to the limiting size of machine which can be satisfactorily designed.

Much has been written on the subject of the large aeroplane. An excellent survey of the development of the present giant machines appeared in *La Nature* for November 16 and 30 from the pen of Lieut. Lefranc; but the author did not commit himself as to future possibilities in the direction of increased size. Mr. Handley Page has been very successful in building large aeroplanes, and his latest machine may be taken as representative of the stage which has now been reached. This machine has a span of about 127 ft., and weighs 27,000 lb. when fully loaded. With sufficient fuel for a 500-mile flight it could carry a useful load of something like 2 tons of merchandise. This in itself is very encouraging, but there is no doubt that attempts will be made to increase the carrying capacity to double or treble this amount in the near future. There is apparently no very great difficulty in doing this from the point of view of the aerodynamic design of the machine, though the provision of sufficiently light controls may give considerable trouble. It is also fairly certain that engines of greater output will soon be available. The greatest difficulty besetting the large aeroplane would seem to be the landing problem, experience having shown that the larger the machine the more difficult it is to land, especially on a bad ground or in a poor light. Moreover, the landing speed cannot be reduced without sacrifice of maximum flying speed, which is the aeroplane's greatest commercial asset. In this connection Mr. Curtiss, the well-known American builder, prophesies the more rapid development of the large seaplane, since the landing difficulties are considerably less than with the aeroplane, and the provision of suitable landing-grounds is not necessary, a large area of still water being almost always available. Mr. Curtiss is at present building a flying-boat of 126-ft. span, and considers that it will be able to accomplish the Atlantic flight during the coming summer. He gives a second reason for the more rapid development of seaplanes, stating that the advantage to be gained is greater than in the case of over-land machines, since the speed of ocean liners is so much less than that of express trains. While this reasoning may be quite correct, there is no doubt that in England the main attention will be devoted to the land machine, most of the useful European and Asiatic routes being over-land.

While considering the possibilities of the giant aeroplane in the commercial world, we must not lose sight of the rigid airship as a means for the transport of merchandise. The speed of the airship is lower than that of the aeroplane, it is true, but the airship has at present far greater capabilities as regards endurance, and might well prove the more useful machine for reaching distant points in a journey of one stage when the utmost limit of speed is not essential. It may here be mentioned that an airship nearly 700 ft. in length, and with a gas capacity of 2,750,000 cu. ft., is already under construction. Announcement was made on December 19 that this ship would have a useful capacity of about 50 tons, a range of 9000 miles, and an endurance of more than eight days. Such a ship, if successful, could be used for commercial enterprises for which any present-day aeroplane would be useless. A rigid airship of 10,000,000 cu. ft., with a useful lift of 200 tons, is said to be under consideration, but it would appear that this is too great an advance to make in a single step, and that the wiser course would be to await the experience gained on the 50-ton ship, and to advance by gentle stages to the colossus of 200 tons. One great disadvantage of the rigid airship is its inability to cope with rough weather, and it is not easy to see how this difficulty is to be overcome, as it must be overcome if such craft are to undertake continuous commercial work. A further disadvantage lies in the fact that an airship can only land in places where a large gang of men is available to handle the ship when upon the ground.

To return to the large aeroplane, it is possible that inventors will try to solve the landing difficulty by the use of the helicopter, or direct-lift principle. There does not appear to be very much hope in this direction, as will be evident when it is stated that with helicopters of reasonable diameter the horse-power required for every thousand pounds lift is in the neighbourhood of 100, while an aeroplane can fly at 60 m.p.h. with only about 22 h.p. per thousand pounds of weight. This consideration, together with the great mechanical difficulties of construction, seems completely to discredit the helicopter, at any rate for the present.

Reference may here be made to a very lucid article by Mr. Handley Page which appears in the January number of the *Fortnightly Review* under the title of "Air Transport." The author traces the gradual increase in the speed of transit of goods from the early days of history to the present time, and shows that the rate of transit is simply a question of weight per horse-power. As the weight per horse-power of the available "engines" has decreased, so has the rate of transit increased. Flying was only rendered possible at all by the development of the petrol engine, the weight of which per horse-power was very much lower than that of the best steam-engine previously available. Even at the present time improvement in the efficiency of flight is much more likely to come from improvement in the engine than from any increase in aerodynamic efficiency. Mr. Handley Page gives his opinion that, even with existing machines, it will be possible to convey passengers at threepence per mile—first-class railway fare—and letters at a penny per ounce. He considers that to realise the advantages of the high speed of aircraft, the stages flown should not be less than 400 miles each.

To summarise the foregoing notes, it would appear that aeroplanes of the largest size built, such as the latest Handley Page machine, form the best basis on which to start commercial schemes of aviation, and that the carrying of mails and limited numbers of passengers should be the first problems attacked. As experience is gained, the size of machines should be gradually increased, and greater loads carried, the difficulties of design and use of the larger machines being thus overcome by degrees. Too much emphasis cannot be laid on the danger of premature attempts to build colossal aeroplanes. To endeavour to build a machine of 50 tons gross weight at the present time would be to court almost certain failure, and to throw discredit upon the large aeroplane, whereas if a machine of this weight is approached by a series of progressive steps in size, there is every possibility that it will ultimately prove successful. Given a steady and well-organised progress, helped forward by the technician as well as by the business man, there is fair ground for the belief that aviation will become a very important factor in the world's commerce, and lead to results which would have been impossible with the older and slower means of transit.

E. F. R.

THE "TIMES" WEATHER REPORTS.

METEOROLOGY in this country has owed much to the enterprise of the Press. In the year 1876 the *Times* inaugurated the service of evening telegrams to the Meteorological Office, and for several years it bore the expense thereof, at first alone, and afterwards in conjunction with the *Standard* and the *Daily News*. It was not until 1880 that the cost of this part of our national weather service was taken over by the Government. After relinquishing its direct connection with the enterprise, the *Times* continued to stimulate public interest in meteorology by including in its pages a copy of the evening weather chart of the Meteorological Office. Upon the outbreak of war publication had to be discontinued, but the issue for January 22 was marked by the revival of this very welcome feature. We are glad also to note that the editor has seen his way to increase the scale of the map, which now occupies the width of two columns of the paper, the change making a vast difference to its effectiveness. It is also of interest to note that the isobars are marked in millibars, as well as in inches, the intervals between them being five millibars. We hope that the day may not be far distant when the blank spaces may be filled by observations. Ships' observations from the Atlantic should soon be available again by wireless, and it seems not too much to expect that these and the French reports may reach this country sufficiently early for incorporation in the map.

Just as in 1876 the *Times* inaugurated the evening weather service, so now it takes the lead in another new departure by publishing a special aviation report. This new section summarises in tabular form the observations of upper winds represented on maps in the special edition of the Daily Weather Report of the Meteorological Office, which has only recently been released from the censor's ban, and supplements it with a section on "Flying Prospects for the Day." Civilian flying and commercial aviation will be realities very shortly, and then reports such as these will have a very real practical interest for a considerably wider circle of readers than the actual aviators. We can imagine would-be passengers scanning the upper air report with an even closer interest than they have in the past bestowed on forecasts of Channel crossings, and that not merely from the point of view of their comfort or discomfort during the flight, for the velocity and direction of the wind must obviously affect the time required for a given journey, just as it did in the old days of sailing-vessels.

Another new and interesting feature of the reports is an adaptation of the forecast for southern England to the peculiar local conditions of the London area.

PITCHBLENDE ORE IN DEVON.

THE *Times* of January 18 reports the discovery of a fine lode containing pitchblende on the Kingswood estate, Buckfastleigh, South Devon, and quotes an analysis of what is stated to be a representative sample of the ore, which shows a uranium oxide content of more than 26 per cent. This is the first time that pitchblende ore has been recorded from Devon. The precise location of the lode is not stated, but Kingswood is situated upon shales of Upper Devonian age, and just outside the area to which the metamorphism caused by the Dartmoor granite has extended. North of Kingswood there are several copper lodes that course in a general east-to-west direction, underlie south, and contain mixed sulphide ores. These were the only lodes hitherto known in the district. Uranium ores where they exist in Cornwall are associated with copper.

In Cornwall the ores of uranium have long been worked at South Terras Mine, near St. Austell, and at Wheal Trenwith, St. Ives, the total output since 1884 being nearly 1500 tons. The ore has also been recorded from many other Cornish mines, notably Crow Hill, St. Austell Consols, Egloshellan, Tresavean, Wheals Gorland, Buller, Unity, and Basset, and at Tincroft, South Crofty, and Dolcoath.

At South Terras the ores associated with pitchblende are nickel, cobalt, and bismuth, and such minerals as kaolin and fluorite. Near the surface the phosphates autunite and torbernite occurred, but gave place at depth to pitchblende of two qualities—namely, "green ore" and "dark ore"—which are reported in a prospectus issued by the Radium and Uranium Syndicate, Ltd., to have contained 6·2 per cent. and 36 per cent. respectively of uranium oxide. The lodes trend north and south, but the pitchblende was confined to a leader, and mostly to the walls of the leader. In the mode of occurrence and associated minerals the lodes show a close resemblance to those worked at Joachimsthal, in Bohemia, and it is held generally that the contents of both groups have been derived from emanations given off during granite intrusions.

It may be mentioned that the principal sources of uranium oxides lie in Portugal and Bohemia, and that the ores from the former country contain on an average about 1 per cent. of UO_3. In America 1000 tons of ore recently yielded 70 tons of concentrate, which contained only 3 per cent. of U_3O_8.

Further developments at Kingswood will therefore be awaited with interest, especially in view of the statements made as to the abnormal richness of the ore in uranium oxides.

NOTES.

A RESOLUTION for the establishment of a League of Nations was passed by the Inter-Allied Conference at Paris on Saturday. It was moved by President Wilson in an eloquent speech, in the course of which he said:—"Is it not a startling circumstance, for one thing, that the great discoveries of science, that the quiet studies of men in laboratories, that the thoughtful developments which have taken place in quiet lecture-rooms, have now been turned to the destruction of civilisation? The powers of destruction have not so much multiplied as gained facility. The enemy whom we have just overcome had at his seats of learning some of the principal centres of scientific study and discovery, and he used them in order to make destruction sudden and complete; and only the watchful, continuous co-operation of men can see to it that science as well as armed men are kept within the harness of civilisation." We have on many occasions pointed out that responsibility for the use of scientific discoveries in destructive devices depends upon statesmen and democracy rather than upon the men who labour to increase natural knowledge. It is for those men to promote the higher national and international feeling of fellowship which will repudiate the doctrine of force as the main factor in the evolution of civilisation, and to encourage the development of science as the chief means of securing human progress. The invention of gunpowder and the use of it in scientific appliances freed the people from the power of the barons in the Middle Ages and altered the political organisation of Europe. Thanks to the existence of scientific workers in the Allied countries, free peoples have been able to establish their cause of righteous dealing against the arrogant military aristocracy of Germany. Political power is now in the hands of democracy, which has yet to prove that it will make noble use of the forces provided by progressive scientific knowledge.

It is rather surprising to find from a study of captured maps and survey documents that the German Topographical Staff was far behind our own in enterprise and originality as applied to war-maps. It certainly has not justified the German reputation for thoroughness and efficiency. The Royal Geographical Society has acquired a number of captured German war-maps, and has placed them on exhibition in the society's rooms. Mr. A. R. Hinks gives some notes on these maps in the *Geographical Journal* for January (vol. liii., No. 1). It is curious to note that, despite their plans of invasion, the Germans do not seem to have provided themselves with a better map of north-east France than a photographic reproduction of the French 1/80,000. Requiring room for more detail, they enlarged this to 1/50,000 and added contours from the hachures of the original, but the result was not particularly satisfactory. Some of the contours have since proved to be wrong. The German Survey Staff does not seem to have been successful in field work under fire; good work, so far as our captures show, was done only on areas well behind the front. But more curious than the failure of the Germans to make good maps is their apparent inability to appreciate them when they fell into their hands through the fortune of war. In Lille they found all the cadastral plans of the Département du Nord, and in Albert quantities of good British maps; yet there is no evidence that they made use of any of these. In sound-ranging the enemy did not come up to our standard, and in flash-spotting he was behind us, at least until a late period of the war. In the use of air-photographs for trench-mapping he seems to have been more successful, and some of his plans of Allied trench systems were useful to our Staff. These and other considerations of a similar nature show that the German Staff was not scientifically organised, and they should be an answer to those critics who still believe that we have anything to learn from the Germans in cartography.

ANCIENT records of Mesopotamia show that the portion of it in the vicinity of Bagdad and southward to Kut-el-Amara was a very fertile region, in which artificial irrigation had been advanced to a high pitch of perfection. Indeed, a number of the old water-channels still remain, though, in most cases, the beds have become silted up during the long period of neglect under Ottoman rule. Prominent among these ancient watercourses was the Shatt-el-Hai, running southward from Kut. To the north-east of Bagdad there was a network of canals intersecting the district enclosed by the Dialah, Adhaim, and Tigris rivers. This district, once noted for its productiveness, had passed out of cultivation when its administration was taken over by the British Irrigation Department of the Expeditionary Force. The *Times* of January 20 announces the complete restoration and widening of the old Mansuriah Cut, with the construction of a solid concrete regulator or dam at the head. By the recommissioning of the channel, which is six miles in length, an area of 300,000 acres has been rendered cultivable. The canal leaves the River Dialah at a point some seventy miles north-east of Bagdad, and passes through a rocky gorge, in which the gradient is 4 ft. per mile. A little lower down a change to 1 ft. per mile is effected by means of five masonry falls. The width of 25 ft. at the entrance is increased to 50 ft. below the gorge. The opening of the Hindieh barrage on the River Euphrates is another instance of British enterprise. It has resulted in the reclamation of a further 500,000 acres for agricultural operations.

THE Registrar-General's return for the week ending January 18 shows a decided decrease in the number of deaths from influenza both in London and for the ninety-six great towns of England and Wales. In London the deaths were forty-three, which is a drop of twenty-five compared with the previous week, and 63 per cent. of the deaths occurred at ages between twenty and sixty-five years. In the ninety-six great towns the deaths were 274, compared with 380 in the preceding week. The deaths are now lower than at any time since the disease became epidemic at the commencement of last October. The *Times* correspondent at Christiania gives a report of influenza in Iceland in the issue for January 24, based on a telegram from an Icelandic merchant, who gives the first authentic account of the great ravage of "Spanish" influenza in Iceland. "When he left Iceland at the New Year about 600 persons had died in the capital, Reykjavik, and its environs out of a population of 8000."

A LARGE diamond of fine "blue-white" quality is reported as having been found in the Jagersfontein mine, Orange Free State. The weight is given as $388\frac{1}{4}$ carats, equivalent to 77·65 grams. The stone is thus much smaller than the "Excelsior" of 199·04 grams and the "Jubilee" of 130·16 grams, found in the same mine in 1893 and 1895 respectively. Another large stone of about 120 grams was found there in 1883 or 1884. The Jagersfontein diamond mine, though producing much less than the Kimberley mines, yields a higher proportion of fine quality stones. For comparison may be added the weight, 621·2 grams, of the "Cullinan" diamond, found in 1905 in the Premier mine, near Pretoria, Transvaal. This, though the largest individual crystal, is not the largest known mass of diamond, for a piece of "carbonado" weighing 631·9 grams was found in 1895 in Bahia, Brazil. These weights are here quoted in grams to avoid any confusion between the old carat weights and the metric carat (one-fifth gram) now in use.

SIR RICKMAN J. GODLEE, Bart., has been elected president of the Birmingham and Midland Institute.

WE regret to see the announcement of the death on January 25, at fifty-one years of age, of Dr. G. S. Corstorphine, principal of the South African School of Mines and Technology, Johannesburg.

MR. F. KNAB, of the Bureau of Entomology, U.S. Department of Agriculture, who died in November last, bequeathed his library and entomological collections to the U.S. National Museum; he also left a sum of money to the Entomological Society of Washington for its publication fund.

SIR AUBREY STRAHAN, director of the Geological Survey, and Eng. Vice-Admiral G. G. Goodwin have been elected honorary members of the Institution of Petroleum Technologists, and Dr. A. E. Dunstan and Mr. W. R. Ormandy members of the council of the institution.

THE third lecture of the series arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, February 5. The chair will be taken at 4.30 by the Right Rev. the Lord Bishop of London, and a lecture entitled "The Industrial Awakening" will be delivered by Mr. Ernest J. P. Benn, chairman of the council. Applications for tickets should be made to the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4.

THE death of Sir James Sawyer on January 27, in his seventy-fifth year, is announced. Sir James was professor of pathology at Queen's College, Birmingham, from 1875 to 1878, when he became professor of materia medica and therapeutics, a chair which he resigned in 1885 on being appointed to the professorship of medicine, which post he occupied until 1891. He was the author of many papers in medical periodicals, and of a number of volumes on medical subjects, including a valuable work entitled "Contributions to Practical Medicine."

NEXT Tuesday, February 4, Prof. J. T. MacGregor-Morris will deliver the first of a course of two lectures at the Royal Institution on "Study of Electric Arcs and their Applications." On Thursday, February 6, Dr. W. Wilson will give the first of two lectures on the movements of the sun, earth, and moon, illustrated by a new astronomical model. The Friday evening discourse on February 7 will be delivered by Prof. J. G. Adami on medical research in its relationship to the war; and on February 14 by Prof. Cargill G. Knott on earthquake waves and the interior of the earth.

THE annual meetings of the Institution of Naval Architects will be held on Wednesday, April 9, and the two following days, in the hall of the Royal Society of Arts, John Street, Adelphi, W.C.2. The Right Hon. the Earl of Durham, K.G., president, will occupy the chair. A gold medal will be awarded by the council to any person not being a member or associate member of council who shall at the forthcoming meetings read a paper which, in the judgment of the council, is deemed to be of exceptional merit. The council will also offer a premium of books or instruments to the reader of any paper, with the same reservations, which, in the judgment of the council, merits this distinction.

SIR R. H. INGLIS PALGRAVE, whose death on January 25, in his ninety-second year, we regret to announce, was a distinguished authority on economics and statistics, and the author of a monumental "Dictionary of Political Economy" published in three volumes, as well as a large number of other books on related subjects. He was editor of the *Economist* from 1877 to 1883, was elected a fellow of the Royal Society in 1882, was president of the Section of Economic Science and Statistics of the British Association at the Southport meeting in 1883, and received his knighthood in 1909. The greater part of his life was devoted to the business of banking, of which, with economics, he was a profound student, and to the literature of which he made many contributions of high distinction.

BY the sudden death of Mr. Wm. Allingham on January 24 the Meteorological Office loses its principal assistant in the Marine Department. Mr. Allingham began his career at sea, but left in early life owing to an accident, and was for some time afterwards employed at the Admiralty. In 1875, at the age of twenty-five, he joined the marine branch of the Meteorological Office, and for some years prior to his death was chief assistant. Mr. Allingham was a prolific writer; he was the author of "A Manual of Marine Meteorology," and joint author of a volume on "Navigation" with Capt. Wilson-Barker, commander of H.M.S. *Worcester*. He also edited the later editions of Lecky's "Wrinkles in Practical Navigation." He was a frequent contributor to the *Liverpool Journal of Commerce*, the *Nautical Magazine*, the *Syren*, and other shipping papers. Mr. Allingham's work was of a specially technical character, and much which was unsigned has been used by the Navy and the mercantile marine.

WE have received the annual report of Livingstone College for the year 1917–18. The college provides for the training of those who intend to be foreign missionaries in the elements of medicine and surgery. Since August, 1915, the college has been utilised as a hospital for wounded soldiers, and supported by voluntary contributions. About 300*l*. is still needed in order that the hospital council may hand over its accounts to the college without a deficit. The patients are now being evacuated, and it is hoped that the college will shortly resume its ordinary work.

THE number of eggs laid by the cuckoo forms the subject of an interesting article by Mr. Edgar Chance in *British Birds* for January. The author kept careful watch on the movements of two cuckoos which were laying their eggs in the nests of meadow-pipits. Assuming that the eggs of any given cuckoo will always present the same peculiarities of coloration—and this is probably the case—he ascribes ten or eleven eggs to one of these birds, and four or five to the other. The smallness of the clutch of the second bird may be attributed, he suggests, to age and diminishing fertility. The author is inclined to believe that the hen cuckoo is able to exercise a "certain amount of control over the reproductive organs, so that the eggs are laid on dates to suit the requirements of the fosterers," and that "it is quite possible also that the number of eggs in the clutch is regulated by the numbers of suitable dupes to be found."

THE discussion on the subject of local war museums which appears in the *Museums Journal* for January shows clearly enough that the ideals of what such museums should be are still in a very crude state. The theme, indeed, is one bristling with difficulties, and calling for the most careful consideration. Unless the greatest care is exercised, such museums will become a serious menace to existing museums, already hindered in their usefulness by lack of both space and funds. It seems to be generally agreed that local museums should confine their exhibits of objects bearing on the war to such as are of strictly local interest. But even if this course is followed, an appalling amount of duplication in the objects displayed will result, without serving any useful end whatever. Everything of debatable value, or which serves no real educational end, should be severely left alone.

REFERRING to Mr. W. R. Nash's article on the diminution of rainfall with elevation above ground in "British Rainfall, 1917," our reviewer remarked in NATURE of January 16 that the results there set forth are "rather suggestive for aircraft." Mr. Carle Salter, joint editor of "British Rainfall," writes to say that the diminution of rainfall with elevation, with which Mr. Nash deals, "represents, not a natural phenomenon, but a defect in instrumental capacity. There may be real variations in the amount of rain falling at different elevations above the ground, but, except at very great heights, the amount of variation is probably trifling in comparison with the large falling-off observed at Greenwich, amounting to 35 per cent. at 50 ft." The article was taken by our reviewer at its face value, and it does not contain the explanation now given of the differences observed.

A SPECIAL article is given in the *Times* of January 20 on "Rainfall in 1918," contributed by Dr. H. R. Mill, director of the British Rainfall Organisation. Detailed rain measurements given show the total fall at numerous stations from all parts of the British Isles; the results, however, are only tentative, and form a small part of the voluminous records from more than 5000 stations, which will eventually be given in "British Rainfall, 1918." The average fall for thirty-five years, 1875–1909, is also given, and the difference of 1918 from the average as well as the 1918 fall as a percentage of the average. The instances of excess are four times as great as those of deficiency. In Wales the excess is 13 per cent. of the average, in Ireland 11 per cent., in England N. 10 per cent., in Scotland 6 per cent., and in England S. 5 per cent. of the average fall. At present the rainfall of the British Isles as a whole, it is said, is passing through a series of alternately comparatively wet and dry years. The driest part of the country with respect to the average was in the north of England and the east of Scotland, where in some places the deficiency was as great as 18 per cent. The greatest excesses of rainfall in 1918 occurred in the west, where the average itself is always the greatest. A map of the British Isles is given showing the relative distribution of the rainfall for the year. Attention is directed to the outstanding feature of the wet September in 1918, when England and Wales had nearly two and a half times the average fall. Rainfall totals for London are given for each month of 1918 and for the year, and the falls are compared with the average for fifty years. The total for the year at Camden Square was 29·69 in., which is 118 per cent. of the average. Rain fell on 195 days, which is thirty-two days more than the normal.

THE paper on "Electrical Oscillations in Antennas and Inductance Coils," by J. M. Miller, published by the U.S. Bureau of Standards (No. 326), will be found useful by mathematical electricians, as it helps to clear up some of the difficult points in the ordinary working theory. The methods adopted at present for measuring the electrical constants of an antenna are on a very dubious footing, and so we welcome this paper. Most authors apply the theory of circuits having uniformly distributed electrical characteristics, such as telephone and transmission cables, to antennas. We have never been able to follow the reason of this practice, and so we welcome Mr. Miller's paper as a serious and partly successful attempt to find a sounder basis on which to build radio-telegraphic practice.

THE Council of British Ophthalmologists has issued the report of the committee appointed to determine standards of illumination of Snellen's test types when used in testing the vision of candidates for the public services. The committee is of opinion that artificial illumination rather than daylight should be used in order that there may be no doubt as to its adequacy. The minimum illumination should be sufficient to ensure that the brightness of the test card is not less than that of a new card with an illumination of 3 foot-candles. The card should have a small surface and be as uniformly illuminated as possible, should not be backed by a contrasting background, or have bright objects or glaring lights near it. The testing-room should be moderately illuminated. Three methods of providing the proper illumination by means of gas, oil, and electric light respectively are described in the report.

THE booklet on "Photomicrography" issued by the Wratten Division of Kodak having gone out of print, it is replaced during the paper shortage by "Notes on the Use of Wratten 'M' Filters." Although much smaller than the other, the new issue includes all the valuable tabulated matter, and, of course, the various items are brought up to date. In the table of the exposure factors for the "M" filters with Wratten "M" plates, the factors for Nernst lamps are withdrawn, and those for the recently introduced Pointolite lamp are introduced. Some new colour filters are described. One converts light from a metal filament lamp into equivalent daylight, and is also advantageously used with the Pointolite lamp and the smaller-powered half-watt lamps. Another is of a neutral tint transmitting only about 3 per cent. of the incident light, and is useful for focussing with a powerful illuminant or lengthening exposure when using low powers. Filters that may advantageously replace the usual green glass are described, and the firm hopes shortly to be able to supply a blue filter to transmit light of a dominant wave-length of 470, especially for visual use when the greatest resolving power is required.

MR. WALTER JAMIESON, of the physics department, Allan Glen's School, Glasgow, has sent us a little instrument for which he suggests the name "Ixioscope"; it is a modification of the spinthariscope of Sir William Crookes. The device consists in a roughly spherical lens made by blowing a bulb on the end of a glass tube and filling it with water. The upper half is then varnished, and while still wet is dusted over with powdered zinc blende containing a very small quantity of radium; viewing this from the bottom through the water, the scintillations due to the α particles are distorted into nebulous points and streaks, and are in constant movement. The streaks of light on the outer edge of the luminous field appear to be in rapid rotation. Mr. Jamieson states that "eight out of ten people insist that the rotation is anti-clockwise." The illusion is certainly striking at first, but a few seconds' concentration leaves one very uncertain, not only of the suggested direction, but also of any actual rotary appearance at all. The effect is probably due to the distortions produced by the imperfect lens giving rise to an apparent maximum of motion on the outer edges of the luminous disc; this suggests a spinning wheel. A worked sphere of glass coated with luminous powder in the same way shows the dancing scintillations in a normal manner, and there is no suggestion whatever of rotation.

THE Cambridge Scientific Instrument Co., Ltd., has issued a leaflet describing typical instruments for use in power stations. By means of a large diagram the company illustrates where some of its instruments can be usefully placed in the boiler-house, dynamo station, and engineer's room. By the use of an electric distance thermometer the engineer can at once tell the temperature of the steam at the stop-valve, of the circulating water at the inlet and outlet, and also of the supply air, condenser, and oil at their inlets and outlets. This leaflet will help the engineer to understand how useful electrical distance thermometers can be. These thermometers can be placed in almost inaccessible positions, such as the base of a smoke-stack or in steam-pipes and economisers. Hence the necessity for men having to climb ladders, etc., at frequent intervals can be obviated. There will also be a great saving of labour in recording the wet- and dry-bulb temperatures in cooling-towers. The leaflet shows an illustration of a distance thermometer recorder fixed on the table in the engineer's room. In the boiler-house it also shows the company's well-known dial draught gauge and its bi-meter CO_2 recorder. As it seems certain that in the near future many huge electric power stations will be constructed in this country, there will be a great demand for all kinds of scientific measuring instruments. The usual custom of placing contractors under money penalties for failure to comply with the steam efficiency guaranteed in the specification is an excellent one. In many cases the cost of the most elaborate thermal tests is but a small fraction of the money penalty at stake. Hence the accuracy of these tests has been much improved of recent years.

MR. C. M. WHITTAKER wrote some time ago to object to some statements made by the reviewer of his "Modern Dyeing Methods" in our issue of November 7 last. Reference was made in the review to inadequacy of treatment of one section of the book, to lack of proportion in another, and to the omission of exact quantitative methods of estimating dyestuffs. It is obvious that upon these matters a reviewer is justified in expressing his opinion, even though it does not coincide with that of the author; and also that no useful scientific purpose would be served by the publication of correspondence upon the different points of view, even if space permitted of it. On one matter, however, we are glad to correct a statement in the review. Though the sections on direct cotton dyestuffs, the insoluble azo-colours, and the resorcine dyestuffs do not give lists of groups at the beginning, as in earlier sections, the examples are included elsewhere in the sections, and our reviewer regrets that he overlooked them.

THOSE interested in the mechanical handling of materials will find a great deal of useful information and applications in the *Electrician* for January 10. Among other subjects treated in this special number is that of the gravity conveyor. On this principle it is worth while to elevate the materials sufficiently at one stage of the process so that their progress thereafter is obtained automatically by gravity. Conveyors on this system have been in existence for many years—for example, in flour mills—but the application has been extended greatly during recent years. The gradient of a gravity installation varies from 2 to 5 per cent.; the latter figure is not the maximum, but it is rarely insufficient. The "humper" is used when it is desired to convey for a distance longer than that obtainable by the available head or fall, and consists of a short mechanical elevator, generally inclined at 45°, which renews the gradient and thus permits the packages to travel to the end of the runway. Roller paths, switches, curves, shoots, and other accessories are described fully in the article. Another section of the journal of interest to engineers is an article on conveyor chains, sprocket-wheels, buckets, etc. This article is fully illustrated with detail drawings. There are also very full articles on the pneumatic handling of cereals, the equipment of silo granaries, and munition-handling devices, which cannot fail to be of service to any desirous of obtaining information regarding these labour-saving appliances.

THE greatest departure in the practice of shipbuilding which has been recently introduced is the extensive adoption of the "straight-frame" system of construction. This was begun and carried out to a very large extent by Sir Eustace d'Eyncourt and Mr. Thomas Graham, who got out designs on this system in the early summer of 1917. The idea of the design is to build a ship the transverse sections of which showed straight sides and bottom intersecting at a point forming an angular bilge, but at the same time retaining the orthodox shape of the waterplanes in a fore-and-aft direction, so that the ultimate features affecting resistance would not present anything likely to demand an increase of driving power. Drawings illustrative of this system appear in an article in *Engineering* for January 17, and we learn from this article that model experiments have confirmed the contention of the designers, and that a suitable adjustment of the "chine" line at the ends would so accommodate the form to the stream-line theory that practically no extra power is required. The Government adopted the type for its "National" (better known as "N"-type) vessels. At present there are built, building, and on order throughout the world on the d'Eyncourt-Graham system vessels representing 750,000 to 1,000,000 tons of dead-weight.

Messrs. Macmillan and Co.'s new list of announcements contains many books likely to be of interest to readers of NATURE. Among them we notice "Annals of the Philosophical Club of the Royal Society," written from its minute-books by Prof. T. G. Bonney; "Botany of the Living Plant," Prof. F. O. Bower, illustrated; vol. ii. of "A Text-book of Embryology—the Non-Mammalian Vertebrates," Prof. J. Graham Kerr, illustrated; "Science and Fruit-growing," being an account of the results obtained at the Woburn Experimental Fruit Farm since its foundation in 1894, the Duke of Bedford and S. Pickering; "Dr. John Fothergill and his Friends: Chapters in Eighteenth-century Life," Dr. R. H. Fox, illustrated; and a new edition—the third—of Preston's "The Theory of Heat," revised by J. R. Cotter, illustrated. Messrs. Macmillan will also publish the following books by American authors:—"Elements of Electrical Engineering," vol. i., "Direct- and Alternating-current Machines and Systems," Prof. W. S. Franklin, and a second edition of "Infection and Resistance," Prof. H. Zinsser. *Messrs. J. M. Dent and Sons, Ltd.*, are publishing "Osiers and Willows," by W. P. Elmore, illustrated, dealing with their cultivation and use. *Messrs. P. S. King and Son, Ltd.*, have nearly ready for publication "The Silk Industry and Trade: A Study of the Economic Organisation of the Export Trade of Kashmir and Indian Silks, with Special Reference to their Utilisation in the British and French Markets," R. C. Rawlley. *Messrs. E. and S. Livingstone* (Edinburgh) will publish shortly vol. iii. of Kraepelin's "Psychiatry"—"Dementia Præcox"—translated by Dr. R. Mary Barclay, and edited by Dr. G. M. Robertson; also "Anatomy Mnemonics." The *Essex Field Club* has in preparation a volume by Miss G. Lister entitled "A Short History of the Study of Mycetozoa in Britain, with a List of the Species recorded from Essex." It will be issued in the club's series of special memoirs.

OUR ASTRONOMICAL COLUMN.

SCHORR'S COMET.—The following observations are reported from Hamburg. Positions are for equinox of 1918·0:—

	G.M.T. d. h. m.	R.A. h. m. s.	N. Decl. ° ′ ″
Dec.	21 7 48·4	3 56 56·8	13 8 14
	24 8 57·8	3 56 21·2	13 24 19
	26 6 42·8	3 56 8·3	13 34 20
	31 11 10·4	3 56 8·2	14 4 2

The magnitude was 15·0.

Continuation of ephemeris:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Feb. 4	4 16 50	17 51	0·3370	0·2106
8	4 21 8	18 17		
12	4 25 44	18 42	0·3435	0·2408
16	4 30 36	19 6		
20	4 35 44	19 30	0·3500	0·2699
24	4 41 7	19 53		
28	4 46 43	20 15	0·3566	0·2980

On December 26 the ephemeris needed the corrections +1s., 0·0′

A CURIOUS FEATURE ON JUPITER.—On the night of January 16, at about 9 p.m., Mr. Frank Sargent, of Bristol, observed a luminous protuberance on the eastern edge of Jupiter. It was situated on the equatorial side of the north equatorial belt. He watched it for some time, and it was visible as a white spot well within the limb of Jupiter, but grew fainter as it advanced further on the disc. Clouds interfered and prevented a transit being taken, but on the following night Mr. Sargent re-detected the object, and it was on the central meridian at about 6.46, though so faint as to be scarcely perceptible. He saw it projecting from the western limb at about 9.5 p.m., when it was quite bright and very easily distinguishable. Luminous projections of this kind are often visible on Mars, and are effects of irradiation, but, in the case of Jupiter, where the atmosphere is considerably denser, the conditions are very different, and it seems probable that the feature observed on Jupiter may have been a real prominence, or it would have been obliterated amid the dense vapours on the limb of the planet.

THE PARIS-WASHINGTON LONGITUDE.—Vol. ix. of the Publications of U.S. Naval Observatory contains the details of the determination of this longitude by wireless telegraphy in 1913 and 1914. The transit instruments used were of 3-in. aperture, with travelling wires driven by electric motors. Every transit was observed with the telescope in both positions, thus eliminating collimation and pivot errors. There were two transit instruments at each station—one for a French, the other for an American observer. The observers interchanged stations when half the observations were obtained. The level error was ascertained by striding levels, the azimuth by meridian marks combined with polar stars. High stars, on both sides of the zenith, were used for clock error, thus minimising the effect of an erroneous azimuth.

The wireless signals were sent from Radio (Virginia) and the Eiffel Tower. The power at Radio was 70 kilowatts, and the wave-length 2500 metres. A rhythmic series of signals was sent, controlled by a pendulum, the period of which was 0·99s. M.T. Coincidences of beats between the Radio signals and the ticks of a mean-time chronometer were noted, a similar comparison being made for the signals of the sidereal clocks, the errors of which were obtained from the transit observations.

The double-transmission time over the distance of 3840 miles is 0·0429s. by the American observers, and 0·0424s. by the French. The deduced speed is 180,000 ± 12,000 miles p.s., practically that of light.

The final result for Washington-Paris is 5h. 17m. 36·653s. ± 0·0031s. The result for period ii. is, however, 0·06s. greater than that for period i.

The seconds of the longitude as given by cable-exchanges in 1866, 1870, 1872, and 1892 were 36·56s., 36·73s., 36·69s., and 36·70s. respectively. The mean is 36·67s., very near the new determination. The longitudes of several other American observatories were deduced by the same wireless signals. The results are appended to the report.

THE ELECTROLYTIC DISSOCIATION THEORY.

AMONG scientific gatherings the general discussions of the Faraday Society have come to occupy a very high place on account of their representative character and practical value. The latest of these discussions, on the present position of the theory of ionisation, held on January 21, was favoured by an interesting contribution from Prof. Arrhenius himself, the last sentence of which is as follows:—"On the whole, it may be said that the dissociation theory corresponds as well with experience as may be expected in the present state of our knowledge." Nowadays few will quarrel with this dictum.

Although the discussion reflected the general opinion that the dissociation theory of solution is the only one worth serious consideration, it also showed that there are still many unsolved problems in connection with solutions. Among these the following deserve special mention:—(1) The question of hydration or, more generally, "solvation" of the ions; (2) the problem of strong electrolytes—that is, the fact that the ionic equilibrium in strong electrolytes does not follow the law of mass-action, which applies so accurately to weak electrolytes (*e.g.* organic acids); and (3) the question of the chemical activity of ions and non-ionised molecules.

Most chemists now consider that ions in solution are associated with the solvent to a greater or less extent. Some go further, and adopt the view first put forward tentatively by van der Waals in 1891 that association with the solvent is the determining cause of ionisation, and that the required energy comes from the heat of hydration of the ions. Although this suggestion is at first sight a plausible one, it is still unsupported by any convincing evidence, and, in any case, is not likely to furnish a full explanation of the mechanism of ionisation.

Further, the many attempts made to determine the degree of hydration of the ions have so far not been very successful. Mr. W. R. Bousfield, who contributed two papers to the discussion, has calculated the degree of hydration of certain ions on the assumption that an ion (with associated water molecules) can be treated as a small sphere moving through the solvent, and that the radius of the complex can be calculated by means of the well-known formula of Stokes. Dr. H. Sand now finds that the application of Stokes's formula in the manner adopted by Mr. Bousfield gives a value for the volume of the hydroxyl ion about one-thirtieth of that obtained by other methods, and he draws the important conclusion that Stokes's formula cannot be applied to particles of molecular magnitude.

The discussion of the problem of strong electrolytes proved of special interest on account of the recent work of Messrs. Washburn and Weiland in America on the dissociation of potassium chloride in very dilute solution (0·00001–0·001 molar). This was rendered possible by the use as solvent of "ultra-pure" water with a specific conductivity of $0.05-0.07 \times 10^{-6}$ reciprocal ohm. The uncertainty attached to measurements in high dilution owing to impurities in the solvent is thus practically eliminated, as the water correction for 0·00007 and 0·00002 molar solutions is only 0·7 per cent. and 2·5 per cent, respectively. From their results Washburn and Weiland draw the important conclusion that the law of mass-action applies between the concentrations 0·00002 and 0·00007 molar, the constant, k, of the dilution formula, $\alpha^2 c/(1-\alpha)=k$, having the value 0·02 at 18°; between 0·00007 molar and 0·001 molar k increases regularly up to a value of 0·052 at the latter concentration. Although it is true that the concentration of the undissociated part, $1-\alpha$, is very small in these high dilutions, yet the accuracy of the measurements is such that the applicability of the dilution law up to 0·00007 molar may be regarded as established. Prof. Arrhenius and others had previously expressed the opinion that the law of mass-action is valid for strong electrolytes in sufficiently dilute solution, but this conclusion was open to doubt on account of the uncertainty in the correction for the conductivity of the solvent. At the meeting considerable difference of opinion was expressed on the question as to whether the validity of the mass law for strong electrolytes in sufficiently dilute solution can be proved by thermo-dynamical reasoning.

The results just described would appear to throw some light on the cause of the deviation of strong electrolytes from the mass law. The fact that the deviation appears in such high dilutions is difficult to reconcile with any explanation based on association between solvent and solute, as this would involve hydration values so great as to be in the highest degree improbable.

Walden and others ascribe the deviation to increased ionising power of the solvent owing to the presence of the electrolyte, and also to the effect of the electrolyte in increasing the ionisation of the solvent. Dr. J. W. McBain and Mr. F. C. Coleman showed in a paper published some years ago that there is no definite evidence of the supposed effect of salts in increasing the ionising power of water, and they show in a contribution to the present discussion, on the basis of migration experiments, that salts do not increase the ionisation of water. The latter conclusion is supported by the fact that the same value is obtained for the dissociation constant of water as determined by different methods, salts being present in some cases, but not in others.

The consideration of the above and other suggested explanations shows that the problem of strong electrolytes is not yet solved, but much may be hoped from the continuation of investigations, such as those of Washburn, with highly purified solvents. The question of inter-ionic forces also deserves careful study, and in this connection a theoretical contribution to the discussion by Dr. S. R. Milner will be read with interest.

Mr. Ghosh (Trans. Chem. Soc., 1918) has recently put forward the view that salts are completely ionised in solution, and that the apparent increase of the molecular conductivity with dilution is due to the operation of electrical forces. On this basis he obtains a formula which permits of the calculation, from known data and a knowledge of the dielectric constant of the solvent, of the ionisation of a salt at a particular dilution and temperature. Dr. J. R. Partington, in an interesting contribution to the discussion, has critically examined Mr. Ghosh's theory, and draws the conclusion that his fundamental assumption, that only electrical forces are operative in the solution, is disproved.

The view formerly held by many supporters of the ionisation theory that only the ions of an electrolyte can react has now been abandoned, since it has been shown independently by Dr. Senter and by Prof. Acree that both ions and undissociated molecules are chemically active. Another aspect of the same subject which has received much attention in recent years is the suggestion that the catalytic activity of strong acids is due partly to H' ions and partly to the undissociated molecules of the acid. If it be accepted that the catalytic effect of acids is a chemical action, this is simply a special case of the chemical activity of non-ionised molecules and their ions. A plausible explanation is thus afforded of the well-known fact that neutral salts accelerate the catalytic activity of strong acids.

Prof. Arrhenius considers the latter question in his contribution to the discussion, but favours an explanation of the accelerating effect of foreign substances based on the assumption that these substances increase the osmotic pressure of the reacting substances, and that the chemical reactivity of the latter is proportional to their respective osmotic pressures. The available experimental data do not allow this interesting suggestion to be tested adequately. G. S.

THE INHERITANCE OF MILK AND FAT PRODUCTION IN CATTLE.

At the Maine Agricultural Experiment Station Mr. John W. Gowen has made a genetic study of the first-generation crosses of prominent dairy breeds of cattle and beef-bred Aberdeen-Angus. This work, the results of which are published in the *Journal of Agricultural Research* (vol. xv., October, 1918, pp. 1–57, 6 plates), was undertaken as a link in the chain of evidence necessary to the final solution of the problems which are connected with the inheritance of milk production and butter-fat production. A cross-bred herd is being formed at the experiment station so as to provide as much material as possible for the analysis of the laws of heredity concerned with the productivity referred to, and this herd has now gone into its second generation.

An indication may be given of some of the important results already reached by Mr. Gowen:—

(1) Black body colour is dominant to the other colour in the first generation. In the second generation an orange-coated bull and a dark Jersey dun-coated heifer were segregated out.

(2) White marking of the body, taken as a whole, appears as a dominant. Study of individual white areas, however, indicates that this is due to white in the inguinal region only, for this alone appears as such a dominant. White spots on the face, neck, shoulders, rump, flanks, and legs are generally suppressed in the offspring when the white-spotted individuals are mated to solid colour.

(3) Pigmented muzzle is dominant to one not so pigmented.

(4) A pigmented tongue is dominant to a non-pigmented one—a confirmation of a previous result.

(5) A black switch appears to cause the suppression of the other switch colours in the offspring.

(6) Some exceptions were found to the previously accepted hypothesis of simple dominance of polledness over the horned condition, and it is suggested that a hormone secreted by the testes may have some influence on the presence or absence of horns. Should this prove true, it would establish an interesting parallel between cattle and sheep, for in the latter a sex hormone is known to affect the development of the horns.

(7) The qualities of beef production are shown to be divisible into four general regions of the body:

head, forequarters, barrel, and hindquarters. When either parent is of Aberdeen-Angus breed the offspring show the characteristic type of head and heavy, deep-fleshed forequarters. The body and hindquarters appear intermediate, but resemble most the dairy parents. From his results so far the author concludes that for the improvement of the beef qualities of dairy breeds the first-generation crosses show an increased value of the beef qualities in the forequarters without materially influencing the hindquarters.

(8) A few data are supplied as to the production of milk and butter-fat by some of the cross-breds. The results indicate that milk and fat production behave separately in inheritance. High milk production is dominant to low, but, unfortunately, a high fat percentage in the milk is recessive to a low fat percentage. The author supplies a useful bibliography and numerous illustrations.

SOME DEVELOPMENTS IN INDUSTRY DURING THE WAR.[1]

Mica.—The electrical industry has proved to be a great war industry. It is bound to become an even greater peace industry. Previous to the war Germany had established a predominant position in this industry, but this would not have been possible without the supplies of mica brought from India and other parts of the British Empire.

Mica is absolutely essential to the electrical industry, and the position of the British Empire in regard to mica supplies was, and is, far and away the strongest of any country in the world. India produces 50 per cent. of the world's supply of mica, and Canada 15 per cent. Germany within her own Empire obtained 10 per cent. of the world's supply, this being found in German East Africa. But, in spite of the overwhelming national advantages of our position at the outbreak of war, the mica market of the world was at the point of being transferred from London to Hamburg, thanks to the skill with which Germany had obtained a large measure of control of the Indian mines and the success with which she had captured the electrical industry. The Indian mica was either exported direct to Germany (she took 47,000 cwt. in 1913) or re-exported from this country to Germany, 50 per cent. of our total imports from India in that year being so re-exported.

The Indian mica can at present be exported to London only, and the mica in German East Africa is now being worked for, and obtained by, the Ministry of Munitions. Thanks to these measures, and to the necessities of war, the British electrical industry has taken the place previously held by Germany and Austria, and is now the first in the world.

The demands for mica for the electrical industry are bound to increase, and the expected developments of commercial aircraft, wireless telegraphy, and motor traction make it essential that the Empire's supplies of this vital raw material should be safeguarded. The electrical industry is bound to be of such importance to the future industrial development of this country that we cannot afford to take risks with the valuable raw material of mica, with which the Empire has been so bountifully endowed.

Tungsten.—Tungsten is essential to the manufacture of high-speed steel, and high-speed steel is a vital war material. Tungsten is also used in the manufacture of metallic filaments for electric lamps, in certain appliances for wireless and other electric uses, where to some extent it has taken the place of platinum, but its principal use is in the production of high-speed steel. Before the war the British Empire produced 40 per cent. of the wolfram-ore from which tungsten is made, but so successfully had Germany captured the trade that no British manufacturer was able to establish the industry in this country. Germany owed her great superiority in munitions production in the earlier stages of the war to the success with which she had captured the industry of tungsten production. All that has been changed. We are now able to produce all the high-speed steel needed for our own industries and to export at a reasonable price to our Allies. British manufacturers are now in a position to deal with all the British Empire production of ore, and could, if necessary, convert the whole world's output into tungsten metal or ferro-tungsten.

Ferro-chrome.—Ferro-chrome also is an essential material in the production of certain classes of steel. Alloyed with steel it acts as a toughener, and is used as chrome-steel for armour-piercing shells, in armour-plate, and for the wearing parts of aeroplane engines and gears in motor vehicles. For peace purposes it will be largely employed for such various purposes as motor parts, stainless cutlery, and rustless steel.

Before the war the United Kingdom production was practically negligible. We have now established at Newcastle-upon-Tyne a plant sufficient to meet our requirements for many years to come. Previously we imported our supplies from Norway, where it was produced by hydro-electric power. At Newcastle the power is obtained from the waste gases from coke-ovens, and the industry will be in the unique position of competing successfully with the cheap water-power of Scandinavia.

Spelter.—Spelter (or zinc, to give it its correct name) occupies the third place in point of importance amongst non-ferrous base metal. The world's consumption in 1913 was 1,012,000 tons, as compared with copper 1,044,000 tons and lead 1,196,000 tons. It is an essential material in industry in the making of a large number of domestic articles and in building construction. Its main uses are for galvanising or coating iron and steel to prevent rusting, and for mixing with other metals to form brass, gun-metals, and other alloys. It is also rolled into sheets for roofing and electrical purposes. The oxide of zinc forms, next to white lead, the most important pigment. It is an indispensable compound of manufactured rubber, and is extensively used for medicinal purposes.

The British Empire is fortunate in possessing in Australia practically unlimited supplies of zinc ore (concentrates), these being amongst the largest in the world. For reasons which it is not my present duty to examine, Germany obtained control of these important ore supplies. She imported from Australia a large portion of her supplies of zinc ore, and on these was able to extend her important zinc industries.

Our own position previous to the war was that we used annually 240,000 tons of spelter in various forms, of which 77 per cent. was imported—practically all from Germany, Belgium, and Holland—Germany being the largest exporter to this country, sending us in 1913 1,500,000*l.* worth of spelter, besides smaller values of sheet-zinc, zinc oxide, and lithopone.

On the outbreak of war these supplies ceased, and we were faced at the same time with a tremendously increased demand for spelter to be used in the making of brass for fuses, cartridge-metal, and so on. Our immediate needs were principally met by imports from North America. The price bounded up from 23*l.* per ton to 120*l.* per ton. This figure led the U.S.A.

[1] From an address to the Industrial Reconstruction Council on Friday, November 29, 1918, by Mr. F. G. Kellaway, M.P., Parliamentary Secretary to the Ministry of Munitions.

smelters to erect new works, and by the middle of 1917 the price had come down to 50*l*.

The need for war purposes was thus met, but it was obviously dangerous to have to depend on outside sources to so great an extent for what was an essential material for war as well as for peace. The first step taken was to divert the stream of zinc concentrates which had flowed from Australia to Germany, and make them flow from Australia to this country. That has been done. These essential raw materials have been diverted—permanently, I believe—to this country. The raw material having been secured, steps were taken to increase the plant available for smelting the ore into metal and for the manufacture of zinc sheets, and the zinc smelters in this country were got together and arrangements made whereby their plants were doubled, and in some cases trebled. Unfortunately, before these extensions were completed the shipping position from Australia became so serious that all shipments of zinc ore from that quarter had to cease.

But that difficulty should soon disappear, and with the ore coming in freely, and labour and coal available for working the increased plants, the home production of spelter should reach 140,000 tons per annum, as against 32,000 tons before the war. The production of zinc oxide has also been encouraged, and on a war basis we are self-supporting, and there is no reason why we should not be self-supporting on a peace basis.

Potash.—Potash is essential for fertilisers and in certain industries, particularly dyes, drugs, and glass production. There are no known natural deposits in this country. Germany possesses large natural deposits, and we depended for our pre-war supplies of 30,000 tons per annum entirely on potash brought in from the Stassfurt mines. The war put an end to this source of supply, and it became necessary to find alternative sources. Investigation revealed the fact that 50,000 tons of potash were going to waste every year in the dust or fume from blast-furnace gases. The problem of collecting these dusts was a difficult one. The only known method was the Halberg-Beth system—a German invention. This was complicated, and required a large amount of steel and labour. The design has been modified to ensure greater trustworthiness, lower capital cost, and a small quantity of steel. Plants in hand and those in course of erection without these modifications should produce 18,000 tons of potash per annum. In addition, the Ministry has initiated an entirely new method of gas-cleaning for the collection of potash-bearing dust from blast-furnace gases. Two large-sized plants are being erected at two blast-furnace works which should produce about 1600 tons per annum. It is confidently hoped that, when these are working, similar plants will be extensively installed, and a considerable increase in potash production obtained.

Magnetos.—Modern warfare, and a great part of modern transport and of modern industry, depend on the magneto. In the air it is an essential source of power and movement. The position of this country in 1914 in regard to the production of magnetos was very grave. Only one firm—Messrs. Thomson-Bennett Magnetos, Ltd., of Birmingham—was producing magnetos. Its output for 1913–14 was 1140 magnetos of a simple type. The Admiralty and the War Office endeavoured to meet our war requirements by importation, but by July, 1915, it had become evident that if we continued to depend on imported magnetos our war effort would be terribly hampered. The Admiralty then undertook to foster the supply of home-produced magnetos for all the fighting Services, and continued this work until it was taken over by the Ministry of Munitions in April, 1917.

The problems to be overcome were many and difficult. Suitable magnets were not obtainable in the British Isles, or the necessary hard rubber insulating material, or fine copper-enamelled wire, or oiled silk or paper for insulation. For the best quality enamelled wire we have still to depend to some extent on the U.S.A., and for oiled silk on Japanese fabric. But the progress made in providing these four essential materials at home has been wonderful. If we are not yet entirely self-supporting, we soon should be.

Instead of one firm producing only 1140 magnetos in a year, as was the case in 1914, we now have some fourteen firms producing 128,637 magnetos in a year. The monthly output at the beginning of the war was 100, the output for October last 18,000, that being the largest figure yet reached. It is not only that we are producing in quantity, which makes us independent of outside sources; the quality of the British magneto is also the highest in the world. It is lighter in weight and more trustworthy in service than the Bosch magnetos manufactured before the war, or than the latest examples found in captured German aeroplanes.

Ignition Plugs.—The ignition plug ranks with the magneto in importance, and it presented similar difficulties. The pre-war output of this country was insignificant. There were three firms manufacturing, and their total output for all purposes during 1914 was not more than 5000. To-day five firms in the country are producing mica plugs, and their output for the year ending October 31 last was 2,148,726. The October output was 303,449, as compared with a monthly output of 420 in 1914. It is gratifying to be able to state that the French, Italian, and American Services endeavoured to obtain British plugs. But there is room for further improvement in the design of mica sparking plugs for aircraft work. I think we can safely rely on our manufacturers not to rest and be thankful, but to make the British plug not only the best in the world—it is that already—but the best that science and mechanical skill can make.

Glass Industry.—This country very nearly lost the war owing to the fact that it was almost entirely dependent on Germany and Austria for scientific and optical glass, and to the backwardness of our glass industry taken as a whole. There were a few refreshing exceptions—firms which had kept the flag flying—but generally it is true to say that we were dependent on Germany and Austria for supplies essential to success in war and for a wide range of peace purposes.

Optical and Scientific Instruments.—Prior to the war the optical and scientific instrument industry in this country was in a lamentable condition, the trade having practically degenerated into a collection of middlemen who mainly sold instruments completely manufactured in foreign countries or bought in foreign parts and assembled them in this country. All that has been swept away by the bitter necessities of war. Our output has increased at least twenty times, and we are now self-supporting. Our pre-war output of optical glass amounted to about 10 per cent. of our peace requirements, the balance coming principally as to 60 per cent. from Germany and Austria and 30 per cent. from France. Our output has developed to such an extent that it is now in excess of that which can be absorbed by this country even under the most favourable conditions in peace-time, and we must look to the development of foreign markets, which previously were the monopoly of Zeiss, of Jena, for disposing of the balance of our home-produced supplies.

Dial-sights.—It is a humiliating admission to have to make, but it is a fact that at the outbreak of war a considerable part of our artillery was equipped with gun-sights exclusively manufactured in Germany. The sight is known as Dial-sight No. 7, and was patented by C. P. Goerz, of Berlin, both in Germany and this country. At the outbreak of war the War Office had already approached the British manufacturers—Messrs. Ross, of Clapham Common, and Messrs. Beck, of Kentish Town—but the position as regards these sights was exceedingly serious when the Ministry of Munitions was formed. The total deliveries to October, 1915, were 1362; the total deliveries to date entirely from home manufacturers are 21,000. The two firms I have mentioned were recently producing 250 per week. The sight is a beautiful and delicate piece of work, and its production in such numbers, and in a perfection which Germany never exceeded, is a triumph for British skill. It is, at any rate, a comfort to know that we no longer have to depend on potential enemies for the sighting of our magnificent artillery.

Scientific Glassware.—This can be divided into furnace-made and lamp-blown. Almost without exception, the furnace-made scientific glassware used in this country was, prior to the war, obtained from Germany and Austria. As regards lamp-blown scientific glassware, there existed a few small firms capable of executing repairs and making a limited number of articles of special design. Beyond this our requirements were met by supplies which originated in Austria and Germany. To show the developments made during the war, it is sufficient to state that, starting at practically nothing, the turnover of the scientific glassware industry is now equal to more than 600,000*l.* per annum. Within a short period, by careful and judicious treatment, this country should be independent of outside supplies.

Illuminating Glassware.—Prior to the war the whole of the glasses for miners' safety-lamps and oil-lamp chimneys were obtained from abroad, mainly from Germany and Austria. Seventy-five per cent. of the glass bulbs, tubing, and rod for electric lamps also came from Germany and Austria. Our dependence on Germany and Austria for the glass for our miners' safety-lamps very nearly landed us in disaster. The position was so serious that the Home Office was forced to relax the very stringent conditions which up to that time had been insisted upon with regard to the quality and dimensions of glasses for miners' safety-lamps. It was a serious thing to do, but there was no alternative, as it was impossible to obtain supplies of the necessary quality. The Home Office came to the Ministry of Munitions for assistance, and, notwithstanding the extraordinary difficulties met with, we are now producing sufficient supplies of the right quality.

As regards oil-lamp chimneys, before the war practically none were made in this country. The position has been greatly improved, but there is room for further improvements.

Then take the position of glass used in the manufacture of electric lamps. Before the war our output of bulbs for this purpose was approximately twelve millions per annum, and three out of every four of the electric light bulbs in use in this country were imported, principally from Germany and Austria. We are now manufacturing sufficient to meet our essential needs.

Then we come to the glass for domestic use, bottles and jars used as containers for foodstuffs and for preserving. Our production in 1914 for vacuum fruit jars alone was 22,317 dozen. In 1918 it was 83,333 dozen. We are now quite self-supporting.

Much more remains to be done by the provision of more efficient works and furnaces, the installation of the most modern machinery, the development of potash production, the training of labour, scientific research, and Government organisation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Francis Maitland Balfour studentship for research in biology, value 200*l.* a year for three years, has again been awarded to Mr. F. A. Potts, fellow of Trinity Hall, who was elected to it in 1913.

A gift of 20,000*l.* to the University of Chicago for the erection of an administration building is announced in *Science* from Mr. Andrew MacLeish, vice-president of the board of trustees of the University.

We learn from the *British Medical Journal* that the medical university at Peking now being erected by the Rockefeller Foundation at a cost of 1,200,000*l.* will be opened not later than next October. Another medical university will be built at Shanghai.

A course of six public lectures on "Physiology and National Needs," arranged in conjunction with the Imperial Studies Committee of the University of London, will be delivered at King's College, Strand, W.C. The lectures will be given on Wednesdays at 5.30 p.m. The first lecture will be by Prof. W. D. Halliburton on February 5 on "Physiology and the Food Problem," and succeedings lecturers will be Dr. M. S. Pembrey, Prof. F. G. Hopkins, Prof. A. Harden, Prof. D. Noel Paton, and Prof. A. Dendy.

On January 2 last the joint session of the Headmasters' Conference and the Incorporated Association of Headmasters passed a series of resolutions which, if carried into effect, will go far to improve the position of science teaching in our schools, especially in the public and the preparatory schools. One of these ran as follows:—"That mathematics and natural science should be necessary subjects in the entrance scholarship examinations of public schools, in the First School Examination, and in the examinations for entrance in the Navy and the Army, provided that good work in other subjects should compensate for comparative weakness in mathematics and natural science, and *vice versa*." Unfortunately, an incomplete version of this resolution was published in the Press, including our issue of January 9 (p. 379), the words "and *vice versa*" being omitted. We are glad to be able to remove the disappointment of those who read the inaccurate reports.

At the general meeting of the Association of Science Teachers, held on January 6 at University College, London, Prof. F. W. Oliver opened the conference on "The Relations between the School and the University in Regard to Science Teaching." He pointed out that, as a consequence of the improvement in the science teaching of schools, the Intermediate Examination is becoming the standard for many of them, and that this results in a repetition of work at the university, as the colleges do not realise that students are better equipped than formerly. In order to bring about greater co-operation between the schools and universities, the teachers in both should have opportunities for meeting for the exchange of views on methods, curricula, etc. Prof. Oliver also suggested that the universities should provide special courses for school teachers to enable them to keep abreast of the advances made in the various branches of science. Prof. Weiss (Manchester) referred to the difficulty of co-ordinating the higher work in schools with the first year's course at the university, and suggested that, instead of specialising in one or two branches, the schools should aim at a more level standard in the general science teaching. If the general level of the school work were raised, the university would be able to remodel the first year's course and to arrive at a higher standard in the Final Examination. Prof. Weiss also expressed the hope that the conditions of the science teachers in schools might be so ameliorated that many of them might engage in original investigations, which would vivify their teaching and enable them to instil a really scientific attitude of mind in their pupils. The meeting passed a resolution that a consultative council of university and school teachers should be appointed to discuss the scope and method of the higher work in schools and its relation to the work of universities.

A SUCCESSFUL conference on the report of the Government Committee on Modern Languages was held at the County Hall of the L.C.C. on Wednesday, January 22. The proceedings were opened by Sir Cyril Cobb, M.P., who said the report had made the question of modern languages a popular one. Mr. Stanley Leathes, chairman of the Government Committee, followed. He dwelt on our ignorance of and indifference to the subject in the past, and insisted on English being the most important language of all, French being next in importance. The position of German would be decided by the importance of Germany. The esteem of the public could alone give modern languages their rightful place in education. Languages should be learnt, not for themselves, but for what they contained. It was not worth while to learn a language badly. Better to learn one language well than two badly. Mr. Gooch dilated on the existing provision for modern languages in London. Lord Crewe, who was responsible for the creation of the committee, insisted on the need for studying the history and institutions of the foreign country as well as the language and literature. Sir Hubert Hamling spoke all too briefly on the value of well-trained linguists to the commerce and banking of to-day. Principal Burrows, of King's College, told of the intensive courses in modern languages recently started by the college. Miss Tuke spoke of the women's interest in the matter. Sir Lulham Pound described the work of the City of London College. Miss Purdie, headmistress of Maida Vale High School, pointed out numerous deficiencies in the existing system. Mr. Fuller dwelt on the gap between the school and the university, which should be bridged by scholarships. Mr. Hedges spoke of the work of the evening institutes, and after a short discussion the proceedings closed with a vote of thanks to the chairman, the question of the future continuance of the debate being left open.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, January 8.—Mr. G. W. Lamplugh, president, in the chair.—Prof. P. F. **Kendall**: "Wash-outs" in coal-seams and the effects of contemporary earthquakes. Two types of interruptions are differentiated in coal-seams which have been confused under the general terms of "wash-outs," "wants," "nips," or "dumb-faults." One type may be due to erosion by contemporary streams which coursed through the alluvial area where the coal material was accumulating. A number of examples of this type in the Midland coalfield are described. Split seams of the type in which the seam rejoins are kindred phenomena, but in these cases the erosion was always contemporary. Great diversity in the phenomena of splits and wash-outs arises from the differences in the ratios of shrinkage during consolidation of the various constituents. Cannel acts as a substance of little compressibility. Other disturbances of the coal-seams, miscalled "wash-outs," are referred to earthquakes. Some of the effects of earthquakes in Coal Measure times might be expected to be of a magnitude greater than the effects of recent earthquakes. An abnormality in coal-seams consists in the intrusion into the coal of sedimentary material or the encroachment of masses of amorphous sandstone as "rock-rolls," probably due to the invasion of sands rendered mobile by excess of water, and perhaps of gas, and moving under the impulse of waves of elastic compression produced by earthquakes. In the roofs of many coal-seams and projecting slightly into the coal are curious conical masses of sandstone, familiar to the miners as "drops." They are wrinkled on the surface, and often have a flange on two sides, showing that they were produced on the site of a crack. They are ranged in long rows. These are interpreted as casts of the funnel-shaped orifices through which the sands surcharged with water have been expelled. Fissures filled with sand or other materials, the "sandstone dykes" of American writers, are not so common in the Midland coalfield as in some other coalfields. They show contortion where passing through the seam, proving that the coal substance had not undergone its full compression at the time when the fissure was produced. A large number of examples of each type of phenomenon, drawn from the examination of more than thirty mines in the coalfield, are discussed.—Dr. A. **Gilligan**: Sandstone dykes or rock-riders in the Cumberland coalfield. These sandstone dykes have been encountered in pits distributed all over the coalfield, but those examined were met with in the workings of the Bannock Band and Main Band seams at Ladysmith Pit. The dykes pass through the Bannock Band and Main Band seams and the intervening measures. They run parallel one to the other in a direction N.N.W. and S.S.E. The inclination of the same dyke is not constant, but the greatest deviation from the vertical was 10° south-westwards. The average width of the dykes was from 2 in. to 4 in., but sometimes they increase to 10 in. or dwindle down to mere films. Splitting of the dykes was seen. The contact of the coal and dyke substance was sharply defined, the coal preserving all its normal features even when adhering to the sandstone. The probable conditions which obtained at the time of the formation of the fissures and their infilling were as follows:—The coal seams through which the dykes pass had been compressed to their present thickness, while they and the associated measures were sufficiently consolidated to take a more or less clean fracture. The sea in which the deltaic material of the Whitehaven sandstone was accumulating covered the area. Fractures were produced by earthquake disturbances set up by movement along one of the N.N.W. and S.S.E. faults, and the sediment on the sea-floor ran in and sealed them up.

PARIS.

Academy of Sciences, January 6.—M. L. Guignard in the chair.—G. **Bigourdan**: A project for the reform of the present civil calendar (Julian, Gregorian). Five principal faults of the Gregorian calendar are enumerated, the last of which, that the dates of the month have no single concordance with the corresponding days of the week, is regarded as the most inconvenient. Statistics made on a weekly basis, such as those of railways, are not easily adjusted to the months or the year. It is proposed to form each quarter of a first month of thirty-one days, followed by two months of thirty days; in the last quarter of the year the last month would always have thirty-one days, in leap years the extra day would be added by making the last month of the third quarter have thirty-one days. The three first quarters would thus have exactly thirteen weeks, so that in each quarter the same days of the week would fall on the same dates of the corresponding months. A tabular comparison of the present and proposed calendar is given, and possible objections are met.—L. E. **Bertin**: The possible creation of a means of Franco-Belgian maritime communication between Antwerp and Marseilles.—Y. **Delage**: Suggestion on the nature and causes of segregative heredity (Mendelian characters) and of aggregative heredity (non-Mendelian characters). Commenting on the Mendelian theory as at present developed, the author points out that to reconcile the principles of the theory with observed facts a constant stream of fresh subsidiary hypotheses is needed. As an alternative to the Mendelian theory the following is proposed: The hereditary mode is a function of the degree of heterogeneity of the parental chromatines.—C. **Guichard**: A series of surfaces of constant total curvature such that their lines of curvature form a network of the type pA', $-(p+1)B'$.—G. A. **Boulenger**: Is evolution reversible? Considerations on certain fishes. The law of Dollo, that there is no known case demonstrating in an irrefutable manner the return of a modified organ to its primitive condition, is called in question. After reference to the work of W. D. Matthew and of L. Errara, examples are given in which there is an undoubted return to a primitive form of teeth. These occur in some African fishes belonging to the family of Cichlides (sometimes called Chromides).—H. **Duport**: Partial differential equations.—J. **Drach**: Determination of the cases of reduction of the differential equation $d^2y/dx^2=[\phi(x)+h]y$.—C. **Rabut**: A new canonical form of reinforced massifs.—Ch. **Frémont**: The premature rupture of pieces of steel submitted to repeated stresses.—R. **Dubrissay, Tripier,** and **Toquet**: A physico-chemical method of estimating alkaline carbonates in the presence of free alkaline bases. Application to the analysis of flue-gas. The method is based on the fact that whilst the hydroxides of the alkali metals increase the coefficient of reciprocal miscibility of water and phenol, the alkaline carbonates act in the opposite sense.—F. **Bourion** and A. **Sénéchal**: The evolution and oxidation of chromic hydrate in alkaline solution.—P. **Bugnon**: A new method of selective coloration of lignified plant membranes. The dye suggested is Lichtgrün F.S. (the sodium salt of diethyldibenzyldiamidotriphenylcarbinol trisulphonic acid), details of the technique being given. Important advantages are claimed for this stain.—M. **Denis**: Some thalla of Aneura deprived of chlorophyll.—J. **Amar**: The origin and consequences of feminine emotivity.—G. **Sanarelli**: The pathogeny of cholera. The natural defence of the peritoneum against the cholera vibrions.

January 13.—M. Léon Guignard in the chair.—G. **Lippmann**: The properties of electric circuits deprived of resistance. The researches of H. K. Onnes have shown that at the temperature of boiling helium the resistance suddenly diminishes practically to zero. Some mathematical consequences are worked out and applied to explain the results of some of the experiments of H. K. Onnes.—G. A. **Boulenger**: A case of ontogenic evolution in an African lizard, *Eremias lugubris*.—J. **Chazy**: Remark on the problems of two and three bodies.—H. **Bourget**: The algebraical development of the principal part of the perturbation function following the method of Cauchy.—R. **Baillaud**: A modification of the prism astrolabe designed to measure variations of latitude.—M. **Swyngedauw**: The influence of the sheath on the effective resistance and reactance of an armoured cable for the 3 harmonics. The effective line resistance and reactance for the harmonic 3 must be determined on the cable in use.—F. **Bourion** and A. **Sénéchal**: The evolution and magnetic properties of chromium hydrate in alkaline solution.—F. **Grandjean**: Calculation of the extraordinary rays for certain structures of anisotropic liquids.—P. **Pruvost**: The existence of Coal Measures at great depth at Merville (Nord). At a depth of 247 metres a black, bituminous schist was encountered, containing 32 per cent. of volatile matter. The boring passes through 31 metres of the lower Coal Measures.—S. **Stefanescu**: The phylogeny of *Elephas africanus*. From a study of the teeth the conclusion is drawn that the ancestors of *E. africanus* have come directly from the bunolophodont mastodons.—H. **Hubert**: The superposition of the air currents above the peninsula of Cape Vert (Senegal).—E. **Mesnard**: The origin and the grouping of meteorological phenomena.—E. **Mathias**: Rain in France: the parasite phenomenon.—C. **Somigliana**: The theory of seismic waves. A development and discussion of Rayleigh's theory of waves.—L. **Eblé**: Vibrations of the soil caused by explosions.—Ch. **Dufour**: Values of the magnetic elements at the Observatory of Val-Joyeux on January 1 last.—J. **Pavillard**: The female flower of Ruscus.—L. **Daniel**: Experimental cultures by the sea-shore.—L. **Lapicque** and E. **Barbé**: The chlorine index as a comparative measure of the richness of soils in humus. Soils remove active chlorine from sodium hypochlorite solutions in amounts which vary probably in the order of the richness of the soil in humus.—D. **Berthelot** and R. **Trannoy**: The absorbing power of dry or moist earth for gaseous chlorine. These experiments had their origin in an attempt to utilise earth as a protection against poisonous gases in the field. Details are given of the results obtained with six soils, both dry and moist.—R. **Dollfus**: Continuity of the line of germinal cells in the Trematods Digenea.—J. **Pantel**: Calcium in the normal physiology of the Phasmides.—M. **Baudouin**: The flattening of the upper part of the body of the humerus in children of the Polished Stone period.

CAPE TOWN.

Royal Society of South Africa, October 30, 1918.—Dr. J. D. F. Gilchrist, president, in the chair.—T. J. **Mackie**: Hæmolysis by serum in combination with certain benzol bodies. It has been shown that while serum-complement acts as hæmolysin in the presence of a specific immune body, and also along with colloidal silicic acid, serum is also capable of producing lysis of red-blood corpuscles which have been treated with certain benzol bodies. The paper records the result of experiments carried out with brilliant green.—J. R. **Sutton**: A possible lunar influence upon the velocity of the wind at Kimberley. The object of this paper is to discuss the question whether there is a lunar term in the velocity of the wind at Kimberley. The results of hourly observations made during 180 lunations reveal only one definite maximum and minimum of velocity in the lunar curve, the former falling about three hours before lunar midnight, the latter just before lunar noon, the range being 0·20 mile an hour. When the moon is in south declination the maximum of velocity is near lunar noon and the minimum near lunar midnight, the opposite being the case when the moon is north, the respective ranges of velocity being 0·32 and 0·55 mile an hour, which are greater than one would have expected to find.—Miss Ethel M. **Doidge**: South African Perisporiaceæ. V.: Notes on an interesting collection from Natal. A number of leaf-fungi are described from Natal, chiefly belonging to the genus Meliola, and including hitherto undescribed species.—A. **Young**: Fusion of Karroo grits in contact with dolerite intrusions. Certain unusual contact alterations occurring in the Heilbron district were described.

Dolerite intrusions have apparently fused the Karroo sandstone or grit to a dark glass resembling pitchstone. The contacts are sharply defined, and the vitrification extends to a distance of several yards from the actual contact plane. The results of a detailed petrological examination of the dolerite, the glass, and the sandstone were described. The dolerite presents no abnormal features. The sandstone contains much soda felspar. The glass on analysis yields about 7 per cent. of soda and about 5 per cent. of combined water. The glass might thus be called a pitchstone. Microscopic examination of the glass shows the presence of microlites of cordierite, magnetite, and also a fibrous mineral with physical properties suggestive of an amphibole. These microlites seem to be practically identical with those described by Harker and Clough as occurring under somewhat similar circumstances in the island of Soay, near Skye.—J. S. v. d. **Lingen** and A. R. E. **Walker**: (1) Hyalite. The points of resemblance between hyalite and liquid spherulites are noted. The truth of the statement that liquid spherulites and, under certain conditions, hyalite give uniaxial figures when examined in convergent polarised light is questioned. (2) Anatase. The authors exhibited a Laue radiograph of anatase, which shows that, according to the usual interpretation of such a photograph, the mineral possesses full tetragonal symmetry. Herbert Smith and W. von Bonde have, independently, suggested that possibly it did not possess the full degree of symmetry usually assigned to it; in both cases this suggestion was based on a study of the external crystal form of the mineral.—A. R. E. **Walker**: (1) Radio-active and other minerals associated with fossil wood from the Beaufort series. A description is given of torbernite and a mineral allied to uranocircite occurring, associated with calcite and barytes, encrusting and impregnating fossil wood from beds of Lower Beaufort age on the farm Quaggasfontein. (2) Tantalite crystals from Namaqualand. A description is given of a number of crystals obtained from a tantalite prospect at Jakals Water, Namaqualand. The collection represents specimens which, solely because they possessed crystal faces, were set aside during the sorting of tantalite from *débris* obtained by blasting. Apparently two distinct varieties of tantalite are represented, which, whilst exhibiting a general similarity of crystal form, consistently differ from each other in certain crystallographic details, in specific gravity and other physical characters, and, presumably, in chemical composition.—J. **Moir**: Colour and chemical constitution. Part v.: The yellowness of certain phthaleins when acid. Phenolsulphonephthalein, on account of its high ionisation, does not form a colourless ring-lactone like phenolphthalein, but remains yellow when acidified; it is really the orthosulphonic acid of benzaurine (which shows similar colour changes). Benzaurine parasulphonic acid and benzaurine-carboxylic methyl-ester ("phenolphthalein methyl-ester") have now been made and found to possess the same property of yellowness in acid solution, lactone-formation being excluded in both cases. The latter substance is coloured pink by bicarbonates, and not bleached by excess alkali. Part vi.: The ultra-violet spectra of the phthaleins. A discussion of Howe and Gibson's discovery of violet and ultra-violet absorption-bands in alkaline phthaleins. These have frequencies which are $1\frac{1}{2}$ times and twice those of the visible band. It follows that the fundamental vibration of alkaline phenolphthalein is still unobserved, being in the infra-red at λ 11,090 (frequency 9·02) on the usual scale. The visible band in the green is its first harmonic, and the other two are its second and third. Part vii.: Inorganic phenomena in connection with cobalt, nickel, manganese, and uranium. Part viii.: Fluorescence and its laws. On comparison of the spectra of dissolved (ionised) salts of these metals with those of the salts in the solid state, "loading" effects are observed similar to those shown by the phthaleins. The formation of blue cobalt compounds is ascribed to considerable increase of molecular weight due to combination with environing molecules. In the case of cobalt halides the wave-lengths appear to be proportional to the eighth root of the molecular weight, and in uranyl compounds they are proportional to the sixth root. The coincidence of these numbers with the periodic place of the element is noted.

CALCUTTA.

Asiatic Society of Bengal, December 4, 1918.—J. **Hornell**: The origin and ethnological significance of Indian boat designs. The principal types of existing small craft comprise:—(1) The catamaran or raft form; (2) the basket-boat or coracle; (3) the dug-out canoe; (4) the outrigger design in two forms, either with (*a*) the float boomed out or (*b*) a transversely placed balance-board amidships; (5) lateen-rigged boats, with grab bows; (6) high-sterned river craft with quarter rudder-paddles or with balanced rudders; and (7) square-rigged river boats with double masts of **A**-form. The catamaran appears to be of indigenous origin, as nowhere else does it show such elaboration as in India; its most primitive form is seen in reed rafts and in plantain stems skewered together. The Indian basket-boat is identical with that used in Mesopotamia, while river craft using quarter steering oars (Ganges) and those with mast triangles (Burma) are distinctively Egyptian in origin. Lateen-rigged craft with overhanging bows are found only on the West Coast of India; they appear to be of Arab origin, representing probably the evolution of the boat form used by the Sabæans of S.W. Arabia in the earliest stage of traffic between Arabia and India. The outrigger design is much more widely spread on Indian coasts than is commonly known. The main conclusions are as follows:—(*a*) That the pre-Dravidian population of, at least, coastal India was largely of Polynesian stock, these fisherfolk using, like the peoples of Malaysia and Polynesia of the present day, outrigger canoes and balance-board proas. (*b*) That the true Dravidians, who appear to be a branch of the Mediterranean race, learned or invented the use of the circular coracle while living in Mesopotamia, and on arrival in India, *via* Baluchistan, introduced the boat forms of the Nile and the Tigris, the former on the great perennial rivers, the latter on those that carry little water in the dry season. Cranial measurements of the various castes in the extreme south of India reveal an unexpectedly strong brachycephalic element in the lower caste population. Various other facts are enumerated pointing to the validity of the author's main hypothesis of a strong Polynesian element in the Indian coastal population.—E. **Vredenburg**: (1) The occurrence of *Cypraea piriformis*, Gray, in the Mergui Archipelago. Amongst the mollusca from the Mergui Archipelago collected by Dr. J. Anderson this shell was referred by von Martens in 1888 to the Australian species *C. xanthodon*. On cleaning the shell it was found to be a perfect specimen of the extremely rare species *C. piriformis*, hitherto only known from Ceylon and North Australia. (2) Two albino varieties of *Cypraea erosa*, Linnæus. The specimens described are from the zoological collections in the Indian Museum. The variety which it is proposed to name *kavlinica*, from New Britain, is almost all white, and a second variety named *purissima*, probably from Queensland, is entirely of a pure snow-white, closely simulating the appearance of *C. eburnea*, Barnes, the only other known instance of an entirely white shell amongst the Cypræidæ. (3) The specific identity of the West Indian *Cypraea henikeri*, Sowerby, and of the East Indian *C. murisimilis*, Martin, with the description of a new species or variety, *C. blandiana*, and remarks on some related forms. A collection of Lower Miocene fossils from San Domingo, presented to the Geological Survey of India by Prof. Gabb in 1874, contains a fine specimen of *C. henikeri*, Sowerby, the study of which has established its specific identity with *C. murisimilis*, Martin, from the Lower Miocene and Vindobonian of Java. This shell is usually characterised by dorsal protuberances similar to those observed in the closely related living species, *C. mus*, Linn. Associated with *C. henikeri* at San Domingo is a hitherto unrecorded fossil, here described under the name of *C. blandiana* as a variety of *C. henikeri* or as a closely related species.

BOOKS RECEIVED.

Pharmacy, Theoretical and Practical, including Arithmetic of Pharmacy. By Prof. E. A. Ruddiman. Pp. vi+267. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

The Examination of Milk for Public Health Purposes. By J. Race. Pp. vi+224. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

L'Insidia Sottomarina e Come fu Debellata con Notizie sul Recupero delle Navi Affondate. By E. Bravetta. Pp. vii+461. (Milano: U. Hoepli.)

Faith in Fetters. By the Rev. T. R. R. Stebbing. Pp. 223. (London: T. Fisher Unwin, Ltd.) 6*s*. net.

Rudiments of Handicraft. By W. A. S. Benson. Pp. 40. (London: J. Murray.) 1*s*. net.

Solid Geometry, including the Mensuration of Surfaces and Solids. By Prof. R. S. Heath. Fourth edition. Pp. 123. (London: Rivingtons.) 4*s*.

A Star Atlas and Telescopic Handbook (Epoch 1920) for Students and Amateurs. By A. P. Norton. Pp. 25+maps 16. (London and Edinburgh: Gall and Inglis.)

Anuario del Observatorio de Madrid para 1919. Pp. 741. (Madrid: Imprenta de la Casa Editorial Bailly-Baillière, 1918.)

The Earth's Axes and Triangulation. By J. de Graaff Hunter. (Survey of India. Professional Paper No. 16.) Pp. viii+219+charts vi. (Dehra Dun: Office of the Trigonometrical Survey, 1918.) 5*s*. 4*d*.

Scientific Reports of the Agricultural Research Institute, Pusa. (Including the Report of the Imperial Cotton Specialist, 1917–18.) Pp. iv+144+xx plates. (Calcutta: Superintendent Government Printing, India, 1918.) 2*s*.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY, at 4.30.—Prof. J. C. McLennan and R. J. Lang: An Investigation of Extreme Ultra-violet Spectra with a Vacuum Grating Spectrograph.—Prof. J. C. McLennan and J. F. T. Young: The Absorption Spectra and the Ionisation Potentials of Calcium, Strontium, and Barium.—Prof. J. C. McLennan, D. S. Ainslie, and D. S. Fuller: Vacuum Arc Spectra of various Elements in the Extreme Ultra-violet.—R. C. Dearle: Emission and Absorption in the Infra-red Spectra of Mercury, Zinc, and Cadmium.—E. Wilson: The Measurement of Magnetic Susceptibilities of Low Order.—Dr. F. Horton and Ann C. Davies: An Experimental Determination of the Ionisation Potential for Electrons in Helium.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 5.30.—Prof. H. H. Turner: Giant Suns.

MONDAY, FEBRUARY 3.

VICTORIA INSTITUTE, at 4.30.—Rev. H. J. R. Marston: The Philosophy of Bishop Butler.

SOCIETY OF ENGINEERS, at 5.30.—W. N. Twelvetrees: Presidential Address: Review of the Development of British Concrete Shipbuilding.

ARISTOTELIAN SOCIETY, at 8.—Prof. Wildon Carr: Philosophy as Monadology.

TUESDAY, FEBRUARY 4.

ROYAL INSTITUTION at 3.—Prof. J. T. MacGregor-Morris: Study of Electric Arcs and their Applications.

ZOOLOGICAL SOCIETY, at 5.30.—Sir Douglas Mawson: Australasian, Antarctic, and Subantarctic Life.—R. I. Pocock: The External Characters of the Existing Chevrotains.

RÖNTGEN SOCIETY, at 8.15.—Dr. F. Hernaman-Johnson: Protection in Diagnostic Work; a Consideration of the Effects of Scattered Rays and Secondary Rays.—Dr. W. Makower: A Langmuir Exhaust Pump.

WEDNESDAY, FEBRUARY 5.

ROYAL SOCIETY OF ARTS, at 4.30.—Ed. C. de Segundo: The Removal of the Residual Fibres from Cotton-seed and their Value for Non-textile Purposes.

GEOLOGICAL SOCIETY, at 5.30.—Dr. A. L. Du Toit: The Geology of the Marble Delta, Natal.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual General Meeting.—D. Pullman: Recovery of Nessler Reagent.—John Allan: Technique of Iodine Determinations: with a Note on a New Machine for Subdividing Oleaginous Seeds.

THURSDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—Dr. W. Wilson: The Movements of the Sun, Earth, and Moon.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* A. Mallock: The Elasticity of Metals as Affected by Temperature.—W. L. Cowley and H. Levy: Vibration and Strength of Struts and Continuous Beams under End Thrusts.—A. Dey: A New Method for the Absolute Determination of Frequency (with a prefatory note by C. V. Raman).

LINNEAN SOCIETY, at 5.—N. E. Brown: (1) Old and New Species of Mesembryanthemum, with Critical Remarks. (2) A New Species of Lobostemon in the Linnean Herbarium.—Dr. J. R. Leeson: Exhibition of Mycetozoa from Epping Forest.

CHEMICAL SOCIETY, at 8.—G. N. White: A Note on the Action of Chloroform on certain Aryl Mercaptans in Presence of Caustic Soda.—J. T. Hewitt and W. J. Jones: (1) The Estimation of the Methoxyl Group. (2) The Estimation of Methyl Alcohol in Wood Distillates and their Concentrates.—P. F. Frankland, F. Challenger, and N. A. Nicholls: The Preparation of Monomethylamine from Chloropicrin.—W. C. McC. Lewis: Studies in Catalysis, Part x. Preliminary Note upon the Applicability of the Radiation Hypothesis to Heterogeneous Reactions.

FRIDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 5.30.—Prof. J. G. Adami: Medical Research in its Relationship to the War.

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

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THURSDAY, FEBRUARY 6, 1919.

MIND-STUFF REDIVIVUS.

The Origin of Consciousness. An Attempt to Conceive the Mind as a Product of Evolution. By Prof. C. A. Strong. Pp. viii+330. (London: Macmillan and Co., Ltd., 1918.) Price 12s. net.

THIS is a very important book. Whether or not we are able to accept its thesis, the acute and exhaustive exploration of the problem of knowledge, and the thoughtful and sympathetic criticism it offers of the present-day theories of new realism and of post-Kantian idealism, must be reckoned with. It is some fifteen years since Prof. Strong gave us a book bearing the fascinating title, "Why the Mind has a Body," and the present work is a development of the theory therein expounded. Perhaps we should rather say that it is a continuation of the author's reflections on that theory, for he acknowledges important changes in his view. The influence of Bergson's theory of creative evolution is very evident in this development, although Prof. Strong is not to be classed as a Bergsonian. The title and subtitle of the present volume indicate that influence. Granting that the fact we name consciousness (meaning awareness) is a product of evolution, what sort of stuff must reality be in order that such evolution should be possible? This is the problem. The answer is that it cannot be any kind of body-stuff of which mind is an epiphenomenon, but it must be a kind of mind-stuff of which the body and the physical universe of which it is part and with which it is continuous are an epiphenomenon.

It will be seen, therefore, that Prof. Strong's theory is panpsychism; indeed, he uses the terms "panpsychism" and "mind-stuff" as synonymous. This marks a complete difference from the mind-stuff theory with which the late Prof. Clifford electrified an older generation. Clifford's theory was a form of psycho-physical parallelism. He supposed a mind-stuff or mind-dust dispersed in the universe as widely as physical matter and correlated point to point with it. Dualism in any form is insupportable to Prof. Strong, its rejection is for him axiomatic; indeed, knowledge itself implies the inconceivability of the independent real. While rejecting alike the "direct object" of the naive realist and the "block universe" of the post-Kantian idealist, his own view yet shows so strong an affinity to some forms of new realism (that, for example, which accepts Berkeley's *esse-percipi* principle, but interprets it realistically) that it is sometimes difficult to see wherein the difference lies. What comes perhaps nearest to it, and may very probably have suggested it, is the theory which James described as neutral monism, the theory that consciousness as a stuff or entity does not exist, and that there is one substance which can appear either as physical or as psychical. Prof. Strong, however, rejects the double aspect or two modes theory, and stands definitely for a mind-stuff pure and simple and ultimate.

When we watch a bumble-bee making frantic efforts to escape through a pane of glass, though an open casement may be only a few inches away, we are astonished at what appears to us the creature's stupidity. Is it a similar failure to pay attention to the obvious which dooms to failure our age-long efforts to solve the problem presented in the simple fact of knowledge? It may be, but so far everyone who has cried "Eureka!" has experienced the impossibility, even if he has satisfied himself, of bringing conviction to others. Prof. Strong is not under the illusion that he can solve by a simple formula what has baffled the ages. Our mistake, he tells us, is in supposing that truth must be simple and direct, whereas it is, in fact, complex and infinitely complicated. The main part of his book is a careful and elaborate discussion of difficulties, real and not imaginary, which can be urged against panpsychism.

The thesis itself is simple. What we know directly in sense-perception are essences, not existences. Consciousness is the "givenness" of essences. Existences have absolute spatial and temporal determinations and occupancy. The essence given to us in sense-perception is not representative of the existence; it is not a *tertium quid* which intervenes between the mind and the reality; it is the "vehicle" of knowledge, the object of which is the existence. Further, the consciousness itself is not an existence; it is "attention" to the "givenness" of the essence. But besides sense-perception there is another mode of knowing, another avenue to the real object; this is introspection. The essences given to introspection are feelings, and the existence to which these are the vehicle is the psyche. The argument is that the object of introspection, the psyche, is the same existence as the object of sense-perception, the spatio-temporal existence, and only the essences are different. A very happy illustration is afforded by the case of the brain. The brain is the unique condition of knowledge, yet it is itself a part of and continuous with the object of knowledge, the body and the physical universe of which the body is a part. It is not possible, of course, to appreciate the argument in a bare epitome. I can only say that it is lucidly expounded, and no difficulty is consciously shirked.

There is, however, to me a serious difficulty of which Prof. Strong, in common with most of the philosophers to whom his arguments are chiefly addressed, appears to be wholly unconscious. When philosophers talk about the independent existence of the objects of knowledge they almost invariably refer to the common-sense objects of daily life—to tables and chairs, mountains, horses, and men—and they discourse about the primary and secondary, and perhaps also the tertiary, qualities of these objects. They ignore completely the fact that physical science has transformed the reality of the common-sense world beyond recognition. They make the naive assumption that the common-sense view of reality is a necessary requirement of physical science. So here, when we ask what is the existence which is distinct from the essence given in sense-perception, space and time and stuff are offered us as the unquestionable framework, ground, and criterion of existence. In this Prof. Strong has, of course, the new realists in mind. But why do the new realists persist in ignoring the evolution of mathematical and physical theory, the principle of relativity, the new concepts of space, time, and velocity, the new scientific world-view of a universe consisting of events and history, in their touching anxiety to save at all costs the common-sense reality of the plain man's world?

This is not intended as depreciation, but as an indication of the real difficulty I feel in regard to Prof. Strong's theory, with which I am in general agreement.

I would advise anyone whom this review may induce to read Prof. Strong's book to begin at the second chapter, entitled "Introduction," and defer the first chapter, entitled "Preliminary," until he has read to the end of the book. The "Preliminary" chapter, probably on account of its brevity and attempt to epitomise, is very obscure in comparison with the main argument.

H. WILDON CARR.

BIOLOGY AND HUMAN WELFARE.

Civic Etiology: A Text-book of Problems, Local and National, that can be Solved only by Civic Co-operation. By Prof. Clifton F. Hodge and Dr. Jean Dawson. Pp. viii+381. (Boston and London: Ginn and Co., 1918.) Price 7s. net.

THIS timely book shows in a graphic way, thoroughly well documented, how much man might improve his place in Nature and his immediate environment if the available knowledge could be utilised in concerted civic action. The coloured frontispiece contrasts an earthly Paradise in Oregon with man-made desert conditions at Shingkung, China, and the idea of the book is: "Which?" "Discovery is pushing forward in every direction as never before in the history of the world, and still it would seem that enough is already known to make living well-nigh ideal and the world almost a paradise, if only *enough* people knew." Yet "probably not less than five hundred thousand valuable lives are sacrificed annually to the currents of preventable disease, along with the several billions of dollars' worth of foods and other property swept away by rats, insects, weeds, and fungi." Unco-ordinated individual effort can do little; co-operative scientific control backed by goodwill offers our only hope of success. "Our education needs to be so organised that every citizen shall know enough to stop a breach the instant he sees it."

The course of instruction mapped out in this book is thoroughly practical and on sound educational lines, as one would expect, of course, for Prof. Hodge is the author of perhaps the wisest of all books on "Nature-study." Rats cost the States some five hundred millions of dollars every year, besides losses inestimable in money, and injurious insects are three times as costly as the rats. This sort of fact occupies a prominent place in the book, and the practicable measures of control are made so clear that he who runs may read. Thus to make the most and the best of the bird life is an obvious communal duty. (We notice, by the way, that the authors refer to the survival of an old passenger pigeon in the Cincinnati Zoological Garden. The death of this bird was reported in England some considerable time ago, but this may have been an exaggeration.)

The inquiry broadens out to include discussion of the following and much more: the careless felling of trees and the disasters of forest-fires; the control of weeds (which do annual damage to the tune of five hundred millions of dollars); making a back door beautiful; the improvement of cultivated plants and domesticated animals; the campaign against flies, mosquitoes, and other serious pests; the control of fungoid and bacterial diseases of plants, animals, and man; the life-histories of parasitic worms; the cultivation of clams and Crustaceans; the improvement of fisheries; and the utilisation of genetics as a basis for eugenics. It is a wide ambit, but the authors are to be congratulated on the skill with which they have used common things to illustrate general principles, and have thrown the light of general principles on common things. So while the course is frankly utilitarian, it is at the same time a discipline in the methods of science.

The book ends with a lively chapter on "Knowing How to Know How," and another on the progress of scientific discovery. The authors are quite sound on the practical value of theory, but they naturally lay emphasis on even the simplest endeavours to face the facts (of any order of magnitude and intricacy) without blinking. They are at one with Goethe when he said: "The most pernicious thing in the world is active ignorance" (or words to that effect), and with Emerson when he wrote: "I am impressed with the fact that the greatest thing a human soul ever does in this world is to see something and tell what it saw in a plain way. . . . To see clearly is poetry, philosophy, and religion all in one." We are heartily at one with the authors in their exposition of what biology may do for human welfare; our only doubt is whether they have put in saving-clauses enough. For there are some readers of easy ambitions who may be tempted to think that all will be right with the world if we get rid of rats and hook-worms, if we control weeds and flies, if we take Pasteur and Mendel into our everyday confidence. Hopes so sanguine will meet, we fear, with bitter disappointment.

J. A. T.

VISIONARY SCIENCE.

Hindu Achievements in Exact Science: A Study in the History of Scientific Development. By Prof. B. K. Sarkar. Pp. xiii+82. (London: Longmans, Green, and Co., 1918.) Price 1 dollar.

SCARCELY would it be supposed from its artless title that this little book deals with what its author styles "the pre-scientific epoch of the history of science," and that its main object, as declared in the preface, is to place the scientific achievement of ancient and medieval India in proper perspective with that of certain other great nations of antiquity. Still less would it be supposed that its text would read sometimes like an awkward demonstration of the truism that Hindu civilisation is an indigenous growth little influenced from outside, and sometimes—indeed, more often—like an unhappy attempt to impugn the accepted opinion that the great flood of Western knowledge had its quickest and freshest rills in the sparkling soil of Hellas.

But, disregarding its misleading title and its ambiguity of profession, one evident purpose of the book is to vindicate the propositions that the "tendencies of the mind" have been pretty much alike in East and West, and that, prior to the present tercentenary, superstition had no more repressive effect in one part of the world than in the other. If "tendencies of the mind" be taken, in the common sense, to include merely the desires, passions, and motives of the wonderful piece of work Man, there needs no ghost to come from the grave of buried India to tell us that these have everywhere and at all times the generic constancy predicated by Shylock; but if it is to denote posture and attention of the mind towards Nature, then the argument that the history of science here reveals no inquisitive difference between East and West must be supported by something more than brave assertion and an ardent imagination.

The author protests that among the sages of Indian antiquity there were numbered "hosts of specialists," who freely explored all fields of Nature by observation and experiment, and systematised the results in "a vast amount of specialised scientific literature." He asserts of these set researches into natural phenomena that they were not less comprehensive, exact, and fruitful than those of the Greeks. Besides the ancient Hindu mathematicians, of whom we have heard, he tells us of physicists, chemists, mineralogists, botanists, zoologists, anatomists, and embryologists, whose discoveries are too vaguely summarised, chapter by chapter. In the chapter on physics little is to be found beyond a disparaging reference to Greece, and a catalogue of fragments of *nuda intellectualia*, to which an imaginative pen may give a local habitation and a name among the formal sciences. The chapter on chemistry tells us that the Hindu chemists of the sixth century were "masters of the chemical processes of calcination, distillation, sublimation, steaming, fixation, etc.," and that the Saracens learnt their chemistry from the Hindus. Under "Medicine" we learn that, in contrast to the impeding "pseudo-science of Galen," the great strength of the Hindus lay in observation of Nature. Under "Anatomy" we are informed, after deprecation of the ignorance of Hippocrates, that the "anatomical system" of the Hindus was "almost modern," although, not containing more than an idea of a circulation, it did not anticipate Harvey. Some of the "Hindu embryologists" approached quite respectfully near the level of present-day knowledge, and the following is quoted by the author as containing a kernel of their truth: "The menses, after conception, goes in part to form the placenta, and as the blood flows every month it coagulates to form the embryo, an upper layer being added every month to the embryo, and another portion to the breasts of the mother." As to "Natural History"—well, *non semper tendit arcum Apollo*; in India—as, it would appear, everywhere else before A.D. 1683—it was not very much to boast of, yet it is declared to have been minute and comprehensive in its scope, and to have been studied in a truly scientific spirit.

OUR BOOKSHELF.

The Science of Health and Home-making. By E. C. Abbott. Pp. xv+352. (London: G. Bell and Sons, Ltd., n.d.) Price 3*s.* 6*d.* net.

ON the whole, this book is a satisfactory introduction to the science of health and home-making, though there are some loose statements which need revision in a future edition. After a brief introduction on the importance of health, succeeding sections deal with the structure of the body and the functions of the various organs, food and digestion, the nervous system, germs and disease, the home, clothing, cookery and housekeeping, the care of babies, and school hygiene.

Under "Food" it is stated that mineral oils are chiefly obtained from petroleum and coal-tar, but no mention is made of the chemical differences between mineral oils and vegetable and animal fats, or that the former have no feeding value. The sections on disease germs, the formation of toxins and antitoxins, and vaccination are inaccurate in many respects. In dealing with the lifecycles of plants and animals it is stated that "plants take in as food CO_2 from the air, and water and salts from the soil, and with these build up starch and proteids." This is correct so far as it goes, but some mention should be made of the importance of nitrogenous compounds. The sections on the care and training of children are quite satisfactory. After every chapter subjects are given for working out practically, and also problems for solving, which should prove very useful to the teacher. The book is written in simple language and in an interesting style.

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.]*

End-Products of Thorium.

MR. J. R. COTTER's letter on this subject (NATURE, January 30), stating that he has been unable to detect the presence of thallium in thorianite, and is confident that it does not contain even 0·005 per cent., is in accord with other evidence of which I have been given private information. I may say, however, that the actual amount of thallium I separated from 20 kilograms of thorite was very small, certainly less than 0·005 per cent., though no particular precautions were taken to effect a quantitative separation, as its presence was only detected during the working up of the whole quantity for lead. Prof. Joly has pointed out (NATURE, June 7, 1917) that the hypothesis of the instability of the major end-product of thorium involves the explanation of the disappearance from the 20 kilograms of mineral of 150 grams of unstable lead, whereas the structure of the thorium halo gives no support to the view that unknown α-ray changes occur in the thorium series.

Not only against the particular suggestion as regards thallium, but also on the general one that one of the end-products of thorium is unstable, the evidence appears now to be against the view. I have no new observations to offer, but Mr. Lawson, writing to me recently from the Radium Institut, Vienna, refers to researches carried out there by Prof. Meyer and others, from which the conclusion has been drawn that both the isotopes of thorio-lead appear to be stable. Referring to elements which an unstable lead could conceivably produce, he mentions my observation of the presence of appreciable quantities of iodine in thorite and the possibility that this may be "eka-iodine" of atomic number 85. I may say that this point was thoroughly investigated four years ago by Mr. J. A. Cranston, who determined its atomic weight, and found it to be that of ordinary iodine.

FREDERICK SODDY.

The Neglect of Biological Subjects in Education.

PROF. BOYCOTT's letter on this subject in NATURE of January 23 deserves the serious attention of those who are striving to secure, as an element in our higher education, some sound knowledge of elementary science and of true scientific method of thought. Quite apart from the important and useful information which would be incidentally acquired from well-directed biological teaching, the student would thus receive an excellent schooling in how to think clearly. It is constantly forgotten that an immense proportion of the subject-matters which concern human beings in their everyday life are on the "biological" side of the border-line which conventionally divides them from the domain of "physics."

It has frequently been shown how ignorant many men in very high places are of the elements of chemistry and physics. To illustrate such lack of knowledge of simple biology would be a very easy task. But the value of some really sound instruction in biology, even only as a mental training, should be widely recognised.

H. BRYAN DONKIN.

London, January 30.

Scientific and Practical Metric Units.

IN the article entitled "Scientific and Practical Metric Units" which appeared in NATURE of October 24, 1918, reference is made to the convenient bridge to the metric system which exists in the ton, and the author asks for a convenient monosyllabic name for a weight of about 2·2 lb. I would commend for consideration the word "seer." The Imperial Indian seer, in common use all over India on the railways, weighs 2·05 lb., and would be as convenient a bridge to the metric system for India as the ton would be at home.

In many parts of Madras the local measuring seer for grain weighs a little more than 2 lb.

G. R. HILSON,
Deputy Director of Agriculture.

Bellary, Madras, S. India.
December 7, 1918.

THE ECLIPSE OF THE SUN ON MAY 29.

IT has been found impossible to organise any British solar eclipse expeditions since those sent to Sweden and Russia in the summer of 1914, just before the threat of war arose. Consequently, advantage is being taken of the cessation of hostilities to arrange for the occupation of two stations in the eclipse of next May by parties sent out by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. This eclipse is noteworthy for the long duration of totality, which is 6m. 50s. in mid-Atlantic, and 5m. 13s. at each of the selected stations. The duration of totality in the eclipses of the same series in the Saros cycle has been gradually increasing, and will reach a maximum of about 7m. 8s. in June, 1955, in the neighbourhood of Manila; this duration will exceed that of any eclipse in the preceding millennium.

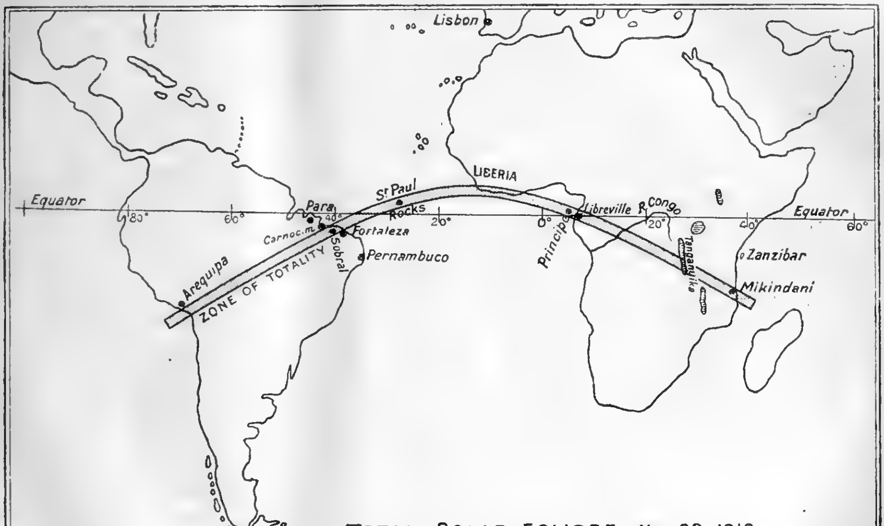
The track of totality next May crosses the entire breadth of South America and Africa. For stations of tolerable accessibility and sufficiently high sun, our choice is restricted to north-eastern Brazil and equatorial West Africa. There is a rather serious error in the maps of the eclipse printed in the ephemerides; they indicate the track of totality as lying to the south of the Liberian coast, but totality will, in fact, be observable on that coast, and the duration of totality and height of sun are greater than at any other land station. However, the weather prospects are not favourable, and it is not proposed to occupy a station there. The selected Brazilian station is Sobral, in Ceara, about 80 miles inland, connected by railway with Camocim, which is reached by steamer from Para. Messrs. Crommelin and Davidson, of the Royal Observatory, Greenwich, are going there, while Prof. Eddington and Mr. Cottingham will occupy the Portuguese island of Principe, 110 miles distant from the African coast, which is reached by fortnightly steamer from Lisbon.

Other possible stations are the African coast, near Libreville, or the high ground to the west of Lake Tanganyika. The weather prospects at the latter place are the best along the track of totality, but the sun's altitude is only about 15°, and the journey is difficult.

There is no information to hand at present as to expeditions from other countries. American astronomers have taken a prominent part in the observation of recent eclipses, but, apparently, they are satisfied with their successful observations in their own country last June, and do not contemplate making observations next May; it is hoped, however, that the South American observatories may take part.

Besides the long totality, this eclipse is also noteworthy for the rich field of stars round the sun; the Astronomer Royal gave a diagram of their configuration in the Monthly Notices for March, 1917, and directed attention to the very favourable opportunity that would be presented for testing Einstein's theory of relativity, according to which a ray tangential to the sun from a star would be deflected through 1·74″, the deflection for other stars being inversely proportional to their angular distance from the sun's centre. Prof. Eddington has directed attention to the deduction that, since a ray of light carries energy, even apart from Einstein's theory, we should expect the same shift as would be produced by the sun's gravitation on a particle passing close to its surface with the speed of light; it is easy to show that this shift would be exactly half that predicted by Einstein, or 0·87″ at the sun's limb. There are thus three possibilities: no shift, the half shift, or the full Einstein shift. The definite establishment of any one of the three as the truth would be an important addition to our knowledge of physics. Should the decision be in favour of the Einstein shift, it would, in combination with the success of the latter in explaining the motion of the perihelion of Mercury, suffice to lead to its acceptance as the actual system of the universe. Its definite disproof would also be of service, since it would avoid the dissipation of further energy in its elaboration, though it would still deserve our admiration as an ingenious system of ideal geometry.

Consequently, the British observers will leave questions of solar or coronal physics altogether alone on this occasion, and will concentrate on the effort to obtain accurate photographs of the star-field round the sun for comparison with photographs that have already been obtained of the same region in the night sky. There are thirteen stars in the region down to magnitude 7·0 within the field of an astrographic plate, which is a square slightly more than 2° in the side; nine of them are as bright as or brighter than 6·0 mag. It is not proposed to give exposures exceeding 10s., and it is hoped that, with restrained development, all the thirteen stars may be recorded without being overpowered by the diffused light of the corona. The object-glasses of the Greenwich and Oxford astrographic equatorials will both be employed, also some smaller lenses of longer focus. The driving clocks of the cœlostats have given some trouble in former eclipses, but they have been carefully overhauled by Mr. Cottingham, and a notable improvement is expected. In any case, exposures limited to 10s. do not require very accurate driving.



TOTAL SOLAR ECLIPSE, May 29, 1919.

The interval of time between totality at the two stations is 2h. 19m., during which the sun will move nearly 6′. Hence the shifts of the nearer stars should be sensibly altered in the interval, giving a further opportunity for verification.

Some photographs were taken for the same purpose in the United States last June, but the publication of results has been postponed until the same region has been photographed in the night sky. The region was much poorer in bright stars than that of next May.

The expeditions propose to leave Liverpool by the Booth line about the middle of March, travelling in company so far as Lisbon, where the Principe party will tranship. It is desired to reach the observing stations three or four weeks in advance of the eclipse.

A. C. D. CROMMELIN.

AMERICA AND GERMAN SCIENCE.

WE have already, on more than one occasion, directed attention to the effect exerted by the war on American opinion concerning German science and on the marked change it has brought about in the attitude of American men of science towards their German *confrères*. The change is the more remarkable in that it is contrary to what might have been anticipated from the leaven of Teutonism which exists in the United States, and from the possible influence of German university-trained men on American education and on American technology. It is well known that the German Government confidently counted upon this element to restrain America from participating in the world-wide struggle upon which it had embarked. As usual, it miscalculated. The "hyphenated" American, who had thrown in his lot with his adopted country, and learned to know and to appreciate its institutions and its ideals, had, with comparatively few exceptions, no real sympathy with Germany's unscrupulous designs to dominate the world and to impose its "Kultur" upon mankind. Where it was well with him, there was his country. Of course, there were traitors, for the most part controlled and instigated from Berlin, but, looking back upon the past, it is remarkable how small their influence was in modifying American opinion, or in thwarting American action.

Public opinion, indeed, thoroughly supported the American Government in its prompt and energetic dealing with covert attempts to undermine the loyalty of American citizens, or with overt acts to injure or terrorise them by outrage and crime. Such attempts, so far from achieving their object, had precisely the opposite effect. An act of outrage and terrorism like the destruction of the *Lusitania*, with its awful loss of life, did more to rouse and stiffen American feeling than any single measure that could have been conceived. As Fouché said, it was more than a crime; it was a political fault, and that of the most egregious kind. The extravagant jubilation with which the crime was everywhere hailed in Germany was the finishing touch to the episode, and greatly intensified the wrathful indignation and disgust of civilised humanity. It was significant that the American troops should go into action with the battle-cry of "*Lusitania!*" and that intellectual and cultured America should visit its resentment upon those of its own class in Germany, who, so far from protesting against this affront to our common humanity, shared the general joy of their countrymen that it had been committed.

Recent attempts to dissect the mentality of German men of science have accentuated this feeling. They and their works have been put through a scrupulous assay, with the result that they are no longer taken at their own valuation. The scales have fallen from people's eyes. In various papers and articles which have appeared in American scientific periodicals we have been given the results of the analysis, and, to say the least, they are not flattering to German self-esteem. Dr. Nutting, in a recent issue of *Science*, describes the methods, "some of them entirely legitimate by every standard, others entirely indefensible by any standard," by which Germany has sought to establish her prestige in pure and applied science. Whilst America in the past respected Germany's diligent productive workers, and contributed, with some qualms of conscience, rather freely to German scientific literature, she smiled at her many false claims to superiority and originality, and generally despised her technologists for their piratical methods. With the coming of the war she was surprised to find how well she got along without her, and how little she was really indebted to her. Whilst it is true that the scientific and technical output of Germany was greater in proportion to population than in any other country, it is not true that scientific ability or originality is higher in native-born Teutons than among other civilised races. This, indeed, has been admitted by such an authority as Prof. Emil Fischer, who, in an address before the German Emperor four years before the war, had the courage to point out to him the shortcomings of the Teutonic mind in originality and creative power. How, then, has Germany gained the prestige she has undoubtedly enjoyed? Dr. Nutting attributes it to what he styles "the intensive factor of publicity"—in other words, to intensive self-advertisement, conscious or unconscious. And he proceeds to indicate in what this has consisted.

It must be admitted that the Teuton mind has the faculty of application—more, perhaps, than that of any other nationality. "A specific problem occupies it to the exclusion of almost everything else. While we [Americans] are prone to work a few hours, then turn to something else, or run off to play, the Teuton eats and sleeps with his problem, takes little interest in anything else, talks shop with his colleagues, and does not completely relax even in his limited recreation."

Our author claims that his compatriots are as ready as any to attack difficult scientific problems, and they are not wanting in incentive. "What we do lack is the 'follow through' thoroughly to search out and master a problem in all its details, generalities, and side issues, before turning our attention to new problems. To minds teeming with ideas all clamouring for attention it is not easy to ignore the many that a few may receive fuller attention." How true this is may be seen by contrasting the methods pursued in German schools of chemistry, where a single conception is hunted to death, as it were, by the professor and his pack of collaborators, who follow it through innumerable ramifications, like a harried hare. It would constitute an interesting statistical exercise to determine the number of Ph.D.'s which have been created by chasing special ideas, with the professor as a whipper-in. Of course, the method is not without its advantages in the interests of knowledge, but its real *educative* value may be doubted, and it certainly does not conduce to develop any latent creative power in the student. It is more frequently directed to serve the interest of the professor than that of his pupils.

Another source of Germany's prestige arose from the comparative cheapness of printing and publication in that country. Struggling men of science eked out a meagre salary by compiling books which were readily accepted for publication on a narrow margin of profit. New serials and journals, and works of reference, were easily started, to find their way into university libraries and State-aided institutions throughout the world as more or less authoritative and indispensable. The output of scientific and technical literature, good, bad, and indifferent, was, in fact, prolific.

Dr. Nutting contends that alien students, university professors, and technical men working in Germany have aided greatly in building up her scientific prestige. These aliens, he calculates, represented fully 10 per cent. in each class—"clear 'velvet' to her, and a corresponding loss to their own countries." The students came, he states, in about equal numbers from Russia, England, and the United States, with a few from Scandinavia, Switzerland, and Japan, but scarcely any French or other Latins. The inducements were easy matriculation and graduation, while fees and living expenses were very moderate—barely half those at Oxford or Cambridge. "The instruction itself was hardly worth any special effort, but it was accessible, and it differed from the home product."

German universities have in the past drawn freely upon foreign countries for their instructors. It has been estimated that a third of the more noted German men of science were foreign-born—Russians, Dutch, and Swiss. These, for the most part, soon became Teutonised, and were thereafter regarded as Germans. The Jews, too, whom the typical Teuton regards as aliens, and secretly dislikes and despises, have contributed in no small measure to the fame of his universities.

German capitalists have always welcomed and been ready to exploit technical men of ability, no matter of what nationality, and a large proportion of the better-known German manufactures have originated in France, Italy, England, or America.

Such are the main factors which, in Dr. Nutting's opinion, have contributed to Germany's scientific and technical prestige. "Plagiarism and piracy," he asserts, "were common practices, and from personal knowledge I doubt whether a third of even the more eminent German scientists were free from this taint. Further, the work of foreigners was taught as the work of Germans in both literature and science. Neither fairy tale nor scientific discovery, if in an obscure publication, was safe from adoption as their own, while the misleading of the young student was easy and common."

Aliena optimum frui insania. American men of science have the wisdom to profit by the errors of the enemy. The war has taught them how to mobilise their man power and to organise their forces of productive achievement. They will, however, not take over that particular code of ethics or standard of literary and scientific morality and conduct by which modern Germany, in her too eager desire for wealth and power, has lowered herself in the estimation of the civilised world.

CLEAN MILK.

THE importance of clean milk, by which is meant a milk free from visible dirt and having a low bacterial content, has been recognised for many years, and various attempts have been made to improve the general milk supply. To a large extent these have failed owing to the conditions which have been supposed to be necessary to attain this end, involving considerable expenditure in reconstruction of buildings and extensive modifications in methods and plant—alterations which, setting aside cost, it is difficult to induce the average farmer and dairyman to adopt.

Recent work, however, has shown that by adopting comparatively simple methods, involving little monetary outlay and but slight modifications in manipulation, it is possible to produce a relatively clean milk vastly superior to that ordinarily supplied.

In a Bulletin (No. 642, 1918) published by the United States Department of Agriculture Messrs. Ayers, Cook, and Clemmer show that it is possible for the average dairyman on the average farm to produce milk practically free from visible dirt and, when fresh, with a low bacterial content by the adoption of three simple factors. These are (1) the use of sterilised vessels, (2) clean cows with clean udders and teats, and (3) the small-top milking-pail. If the milk is to retain its low bacterial content for any time a fourth factor is necessary, viz. the keeping of the milk at as near a temperature of 50° F. as possible. Each of the factors mentioned contributes something to the lowering of the dirt and bacterial content, as shown by the experimental results obtained, the experiments being conducted in many instances in barns which can only be described as filthy.

First, with regard to the small-top pail; this is a pail with a lid covering, say, two-thirds of the top of the pail. Using *unsterilised* pails without any other precaution, the open pail gave an average per cubic centimetre of 497,653 bacteria, while the small-top pail gave an average of 368,214 bacteria—a 25 per cent. reduction. With *sterilised* pails, under the same conditions, the numbers were 22,677 and 17,027 respectively, an enormous reduction by the additional precaution of using sterilised utensils. Washing of the udder and teats reduced the bacterial content of the milk by about 50 per cent. By a combination of these three factors it was possible to produce a milk containing only 2000–3000 bacteria per cubic centimetre even on farms which by any ordinary standard would be considered to be very unhygienic. The original cost of a small-top pail is little more than that of an ordinary open pail, and it is no more expensive or difficult to care for. Prof. Delépine, in a report (1918) to the Sub-Committee on Clean Milk of the Sanitary Committee of the Manchester City Council, arrives at much the same conclusions. He summarises the points requiring special attention as follows: (1) Cleanliness of the shippens, cows, milkers, utensils, and dairy-hands; (2) protection of milk against dirt during milking; (3) sterilisation of milk pails, churns, etc., and their protection against re-infection pending using; (4) protection of fresh milk against admixture with stale milk; (5) avoidance of straining through a common strainer; (6) avoidance of cooling by methods causing large surfaces of milk to be exposed to the air or to unsterilised surfaces; and (7) cooling of the milk by keeping churns in cold stores or places.

Prof. Delépine advocates the use of the small-top pail or some similar device. He finds that pails, coolers, and churns cleaned with very pure cold and hot water, and apparently scrupulously clean, are still capable of imparting a large number of bacteria to the milk, and urges the importance of steam sterilisation of the utensils. This last condition is not so difficult to accomplish, even on the small farm, as might at first sight appear, for simple and inexpensive steam generators can be devised. With a small boiler holding six quarts of water, heated with a paraffin stove and boiling in six minutes, it is possible to sterilise at one time six two-gallon pails or cans in fifteen to twenty minutes. By ensuring clean cows and milkers, and the use of sterilised utensils and of the small-top pail or similar device, really clean milk with a very low bacterial content, and therefore with enhanced keeping qualities, can be produced without of necessity the expensive remodelling of cowsheds and premises, and with very little disturbance of the time-honoured routine of the ordinary farmer or dairyman on the average farm.

R. T. HEWLETT.

NOTES.

SIR NAPIER SHAW has been elected a foreign member of the Reale Accademia dei Lincei of Rome.

WE notice with much regret the announcement in the *Times* that Prof. E. C. Pickering, director of the Astronomical Observatory of Harvard College, died on February 3 at seventy-two years of age.

A SPECIAL general meeting of the Geological Society will be held on Wednesday, March 26, to consider the resolution of the council of the society:—"That it is desirable to admit women as fellows of the society."

THE Institution of Civil Engineers has elected upon its roll of distinguished honorary members Marshal Foch, O.M., Field-Marshal Sir Douglas Haig, K.T., and Admiral Viscount Jellicoe of Scapa, G.C.B., O.M.

THE gold medal of the Royal Astronomical Society has been awarded by the council to M. Guillaume Bigourdan for his observations of nebulæ, carried on for about twenty-five years. It will be presented at the annual general meeting of the society on Friday, February 14.

AT the general monthly meeting of the members of the Royal Institution, held on February 3, a bequest of 300*l.* was reported from the late Dr. T. Lambert Mears, who was a member of the institution for fifty-three years, and a donation of 50*l.* from "an old member" in celebration of his fiftieth year of membership.

WE learn that M. G. Grandidier has been appointed general secretary of the Société de Géographie of Paris in succession to the late Baron Hulot. Baron Hulot, who had been secretary of the society for more than twenty years, was an occasional contributor to the pages of *La Géographie*. One of his most important papers was a life of d'Entrecasteaux, which appeared in 1894, and was the first complete biography of the explorer. M. Grandidier is well known for his researches in the exploration and geography of Madagascar.

THE Royal Horticultural Society in its report for 1918, which has just been issued, makes the important announcement that the revision of "Pritzel" is now in hand, and that the work of preparing it for the press is in progress at Kew under the personal supervision of Capt. A. W. Hill. It is estimated that the work will include about 250,000 references, and its cost of production will be at least 3500*l.*, towards which assistance is asked from the botanic stations, experimental stations, and libraries of the world as well as from private subscribers. All subscribers of 15 guineas will receive a free copy, and those of larger amounts a specially bound copy, according to their donation.

IT was announced by the president of the Royal College of Physicians on January 30 that the Swiney Prize, the award of which is adjudicated by a joint committee of the College and of the Royal Society of Arts, has been awarded to Dr. C. A. Mercier for his work on "Crime and Criminals." Dr. Raymond Crawfurd has been appointed to deliver the Harveian Oration of the College on St. Luke's Day, October 18, Dr. A. P. Beddard to be Bradshaw Lecturer, and Dr. Aldo Castellani to be Milroy Lecturer for 1920. Dr. J. McVail will deliver the Milroy lectures on "Smallpox and Vaccination since 1870," on March 13, 18, and 20; Dr. Topley the Goulstonian lectures on the "Spread of Bacterial Infection," on March 25 and 27 and April 1; and Sir H. D. Rolleston the Lumleian lectures on April 3, 8, and 10, taking as his subject "Cerebrospinal Fever."

At the annual general meeting of the Royal Anthropological Institute, held on January 28, the following were elected as officers and council for 1919–20 (the names of new members are in italics):—*President: Sir Everard im Thurn. Vice-Presidents:* M. Longworth Dames, *S. H. Ray*, and Dr. W. H. R. Rivers. *Hon. Secretary:* Dr. H. S. Harrison. *Hon. Treasurer:* R. W. Williamson. *Council:* Capt. F. R. Barton, L. C. G. Clarke, *Miss M. E. Durham*, Dr. W. L. H. Duckworth, Sir J. G. Frazer, *Capt. A. W. F. Fuller*, Dr. R. J. Gladstone, Dr. W. L. Hildburgh, *Capt. T. A. Joyce, H. G. A. Leveson*, A. L. Lewis, Miss M. A. Murray, *E. A. Parkyn, Prof. F. G. Parsons, W. P. Pycraft, Capt. C. G. Seligman*, Dr. F. C. Shrubsall, *Lt.-Col. L. A. Waddell*, S. Hazzledine Warren, and *Prof. W. Wright*.

Prof. Icilio Guareschi, who died recently after a very short illness, was professor of pharmaceutical chemistry and toxicology in the University of Turin and director of the Institute of Pharmaceutical Chemistry. He was one of the leading Italian chemists, devoting himself chiefly to researches on the alkaloids. The most important of his published investigations in this field were his chemical, physiological, and medico-legal researches on the ptomaines, but he also worked upon the derivatives of quinoline, on cocaine, on creatinine, etc. These investigations led ultimately to the publication by Prof. Guareschi of a volume summarising our knowledge of the alkaloids. This work was translated from the Italian into several other languages, and gained for the author a world-wide reputation. During the war he carried out investigations on the toxic gases used in chemical warfare, and much of his leisure was devoted to the study of the history of eminent chemists and physicists.

Paris last week was greatly delighted with M. Guitry's five-act play *Pasteur*. M. Guitry *père* acted Pasteur, M. Guitry *fils* wrote the play; we are thus reminded of that filial affection which was one of the many inspirations of Pasteur's life. The play begins with the dispersal of Pasteur's students from the Ecole Normale at the call of the war of 1870–71; it ends with the celebration of his seventieth birthday, when the representatives of every country of the civilised world came to Paris to honour him and thank him. Lovers of the "Vie de Pasteur" and of Godlee's "Lister" do not need to be told about Pasteur. To those who saw Pasteur, sat at table with him, heard the slow, grave, quiet voice, watched the keen eyes and the tired, sad look of the face, it will be strange to think of him put on the stage. Besides, the life of a man of science is not a good theme for a five-act play. Galileo might stand through an act or two, or Vesalius—for the Holy Inquisition would make a "good curtain"—but Euclid, Aristotle, Newton, Galvani, Faraday, Darwin, are not figures for a theatre. What has Science to do with Drama? But Pasteur stands not for science alone; he stands for France. His father had served in the Grand Army; had received the Legion of Honour; had taught his children to believe in France, in her God, and in her glory. Pasteur was possessed, heart and soul, by the love of home and the love of France. The war of 1870–71 half-killed him. What could he do to help and console and glorify France in his life? "Henceforth," he said, "every one of my books shall have it written across them, *Revenge, Revenge*." That was his share of *la revanche*: to raise France out of the horror of defeat, exalt her over Germany, set her on her throne, by the work of his thought. That is what he did, what he lived for. "Science," he said, "has no country of her own; but the man of science ought to have a country of his own." Pasteur represents everlastingly the spirit of France, the genius of France. So it is a good thing, in this wonderful year, that some likeness of him should live and move before the scenes of a Paris theatre; that some of his words should be spoken by a living voice in the city where his body was buried. It would not be surprising if the Germans, a few years hence, should want to translate the play and produce it in Berlin as an educational instrument to teach the importance of bacteriology for the advancement of material prosperity.

Sir Arthur Newsholme has retired from the post of Principal Medical Officer to the Local Government Board a year or two before the time when his period of office would actually have expired under the Civil Service age limit—probably in anticipation of changes in the Department incidental to its incorporation in the proposed Ministry of Health. During his tenure of office Sir A. Newsholme has been responsible for special developments of public health work in various directions to which comparatively little attention had been directed in official quarters. Among these may, perhaps, be regarded as most important the introduction of the notification and treatment of tuberculosis, a general scheme for the treatment of venereal disease, and one for the advancement of maternity and child welfare work, in this latter respect continuing and expanding the pioneer work of his predecessor, Sir William Power. As addenda to his annual reports on the work of the medical department, Sir A. Newsholme published a series of reports dealing with the question of infant mortality and the various factors found, as the result of special inquiries by members of the inspectorial staff, to have a bearing on it, especially in a number of manufacturing areas, where, although, so far as was previously known, the conditions were somewhat similar, nevertheless the infantile death-rate varied within wide limits. Mention should also be made of the "General Review of Progress since 1871," published as an introduction to the report of the Medical Officer for the year 1917–18, in which the saving of life which has occurred in the forty years since the appointment of Mr. (afterwards Sir) John Simon as the first Medical Officer of the Local Government Board is illustrated by a comparison of the death-rate at different ages in 1911–15 and 1871–80 respectively. During the whole period of the war Sir A. Newsholme has acted on the Army Sanitary Committee, holding the rank of Lieut.-Colonel, R.A.M.C. (T.), and it has been largely due to his efforts that military and civilian public health authorities have worked together so harmoniously on the various special problems which developed as the outcome of war conditions. In acknowledgment of his services to the State, Sir Arthur Newsholme was created a C.B. in 1912 and a K.C.B. in 1917.

The death is announced, in his fifty-first year, of Prof. Wallace Clement Sabine, who had been professor of mathematics and natural philosophy at Harvard since 1905, and was formerly dean of the Lawrence Scientific School. Two years ago Prof. Sabine was Harvard exchange professor at the University of Paris. He was the author of a treatise on "Architectural Acoustics."

Isis, an international quarterly devoted to the history and philosophy of science, commenced publication in Belgium in 1913. A complete volume had appeared, together with two or three fascicules of the second volume, when the publication was brutally interrupted by the German invasion. M. Sarton, its editor, was hospitably received in the United States, where during the last four and a half years he has conducted a number of very successful courses of lectures on the history of science at several universities. We are glad to hear that he is about to visit Europe again in connection with the restarting of his journal, of which the materials for vols. ii. and iii. are almost ready. We understand that M. Sarton may be joined by Dr. Charles Singer, who has worked in England on somewhat similar lines, in subsequent periodical publications in connection with the history of science.

THE death is announced, in his seventy-ninth year, of Dr. Rossiter W. Raymond, one of the leading American authorities on mining. Dr. Raymond graduated at the Brooklyn Polytechnic Institute in 1858, and, after pursuing further studies at Munich, Heidelberg, and Freiberg, served with distinction in the American Civil War. In 1866 he became editor of the *American Journal of Mining*, afterwards the *Engineering and Mining Journal*, to which he remained a contributor up to the time of his death. From 1868 to 1876 he was U.S. Commissioner of Mining Statistics, and in that capacity acquired a great reputation for his investigations and reports. Dr. Raymond was one of the founders of the American Institute of Mining Engineers, of which he was president from 1872 to 1874 and secretary from 1884 to 1911. He was the author of "Mineral Resources of the U.S. in and West of the Rocky Mountains," a glossary of mining and metallurgical terms, and various other technical works and papers.

NEWS has been received, by telegram from Cape Town, that Dr. G. S. Corstorphine, principal of the South African School of Mines and Technology, Johannesburg, died on January 25. Dr. Corstorphine was appointed to the principalship of the college in 1913, and was recognised as one of the leading South African geologists and mineralogists, and a very eminent authority on questions connected with the geology of the Rand goldfield. Born in Edinburgh in 1868, Dr. Corstorphine was first trained for the teaching profession, and passed through the Moray House Training College course. He soon, however, developed a marked interest in science, and studied at Edinburgh University, principally in biology and geology, obtaining the Baxter science scholarship in 1892 for the most distinguished graduate for the year in those subjects. Thereafter he was appointed university assistant to Prof. James Geikie, and was, fortunately, able to devote a considerable part of each year to study abroad. Munich was in those days a favourite resort of Scottish students for post-graduate work, and under Prof. Groth and Prof. Weinschenk Dr. Corstorphine's interest in mineralogy, petrography, and geology was greatly stimulated. He took the degree of Ph.D. in 1895 with a thesis on some igneous rocks from the south of Arran, which was his only contribution to British geology. In 1896 he went to Cape Town as professor of geology in the South African College. He was also keeper of geology in the museum, and received appointment as director of the newly instituted Geological Survey of Cape Colony. In 1902, however, the attractions of the Rand drew him away from Cape Town, and he went to Johannesburg as consulting geologist to the Consolidated Goldfields Co. Later he set up in practice as a consulting geologist in Johannesburg, and his advice was much in request by mining companies. His best known work is "The Geology of South Africa," which he wrote jointly with Dr. F. H. Hatch. First published in 1905, the volume is now in its second edition. Dr. Corstorphine wrote several papers on problems of Transvaal geology, in some of which he had Dr. Hatch as collaborator. He was president of the South African Geological Society in 1906 and honorary secretary from 1910 to 1915.

AT a meeting of the Society of Antiquaries held on January 30, Capt. R. Campbell Thompson read a paper on the excavations which he had conducted by War Office orders on behalf of the British Museum at Abu Shahrain, in Mesopotamia. This place, the Eridu of the cuneiform records, lies in the desert about twenty miles south-west from Nasiriyah. It was partially excavated by J. E. Taylor in the middle of the last century, but the value of his discoveries was not at the time appreciated. The results of the recent excavations are of high scientific importance. Numerous chipped and ground celts and flakes show that the early inhabitants lived in the Stone age. More important even is the pottery of buff, wheel-turned clay, painted with geometric designs in black, exactly similar to that found in the lowest stratum at Susa by M. De Morgan. Though the people of Eridu were ignorant of writing, their culture was decidedly advanced. They lived on cereals and on fresh-water mussels from the Euphrates, which must then have flowed near the city. The relics represent the pre-Sumerian population which occupied southern Mesopotamia before the arrival of the Sumerian race.

DR. W. E. COLLINGE, 3 Queen's Terrace, St. Andrews, has issued a circular announcing the proposed foundation of an organisation and publication that will bring together students of wild birds. The objects of the Wild Bird Investigation Society are:—(1) The more intensive study of the ways and habits of British birds; (2) the protection of all beneficial and non-injurious wild birds and the repression of really injurious species; (3) the influencing and educating of public opinion as to the destructiveness or usefulness of wild birds to agriculture, horticulture, forestry, etc., by means of publications, meetings, lectures, etc.; (4) the discouragement of egg- and bird-collecting, except under guidance or for scientific purposes; (5) the improvement and modification of the existing laws relating to wild birds; (6) the establishment of bird sanctuaries under efficient control; (7) the discussion and consideration of these matters from all points of view; and (8) the establishment of local branches throughout the United Kingdom. At a later date it is proposed to call a general meeting for the purpose of approving the draft rules and to elect officers. Further particulars may be obtained from Dr. Collinge at the above address.

THERE seems reason to hope that prosperity is returning to the Zoological Society of London, which has come singularly well through a very anxious time. At any rate, at the monthly meeting of the society held on January 15 it was announced that there had been an increase in the gate-money received during 1918 of 544*l*., as compared with the total amount received during 1917. The most important additions to the menagerie during the month were a chimpanzee from Sierra Leone and thirty-two lizards, including eight starred lizards from Salonica, sent by Capt. W. D. Motton and Mr. G. H. Colt.

THE hawks of the Canadian prairie provinces in their relation to agriculture forms the subject of a valuable Bulletin (No. 28) by Mr. P. A. Taverner, issued by the Canadian Department of Mines. The author briefly, but lucidly, summarises the distinguishing features of the various species of hawks and falcons of these provinces, so that they may readily be identified by the farmer and sportsman, and, further, indicates the prey of each. One or two species he condemns on account of their ravages on game or poultry. But for the most part he urges protection, pointing out the immense services of these birds in keeping down the gophers, which, apart from the great quantities of grain they consume, have become a serious menace on account of the diseases they spread, not only among cattle, but also among the population of the rural districts. Text-figures and four most excellent coloured plates add greatly to the usefulness of this work.

THE animal remains found in kitchen-midden deposits are relics of importance to both anthropologists and zoologists. Hence we are much indebted to Mr. Alexander Whetmore for his account of bird-bones found in kitchen-midden deposits in the islands of St. Thomas and St. Croix, published in the Proceedings of the United States National Museum (vol. liv.). Altogether thirteen species are represented in these deposits, of which one, a rail (*Nesotrochus debooyi*), is new to science. One or two species are now no longer found in a living state on St. Croix, and this is attributed to the fact that the early French settlers, somewhere about 1650, burned off the densely wooded covering of the whole island in order that they might render it more healthy, since up to that time fevers and other diseases had taken a heavy toll of the settlers. This conflagration, of course, entirely changed the character of the flora and fauna, and this fact has to be borne in mind by students of geographical distribution.

UNDER the title of "The Louse Danger," the British Museum (Natural History) has issued a third "poster" in the economic series. Attention is directed therein to the danger of the clothes (or body) louse as a carrier of relapsing fever, typhus, and trench fever. In order to avoid lice, regular washing of underclothing and bed-linen is advocated. It is further desirable to avoid contact with persons suspected of being verminous; hospital workers and others are advised to wear white linen overalls. For the purpose of getting rid of the lice, a hot bath, followed by a change of underclothing and immediate disinfestation of verminous garments, is an important measure. When eggs of the louse are present in the hair, close clipping or shaving is necessary; in the case of women, washing the hair with an insecticidal solution is advised, followed by thorough combing with a fine-toothed metal comb. Simple instructions for the disinfestation of clothing and bedding are appended, together with information concerning the most useful insecticides. The poster is written in a clear and easily understood style, and is well adapted for the purpose for which it is intended.

IN the Kew Bulletin (No. 10, December, 1918) W. G. Craib gives a further instalment of his "Contributions to the Flora of Siam." Fourteen new species are described, belonging to ten families of flowering plants. They are mainly jungle plants collected by Kerr. The most interesting is a new genus of Gesneraceæ, Damrongia, allied to Didymocarpus, and named in honour of H.H. Prince Damrong, "who, himself interested in scientific pursuits, has done so much for the advancement of education in his country."

IN the *Philippine Journal of Science* (vol. xiii., Section C, Botany, No. 5) E. D. Merrill continues his taxonomic work on the flora of the Philippines. Eighty-four new species, distributed among twenty-six families, are described, the principal additions being in the families Loranthaceæ, Myristicaceæ, Meliaceæ, Araliaceæ, Gesneraceæ (Cyrtandra), and Asclepiadaceæ. There is one new genus, Acanthophora (Araliaceæ), allied to Aralia, but recalling Acanthopanax in habit. It is a sparingly branched climber sprawling over thickets, with large compound leaves 3–5 ft. long, and an ample terminal inflorescence about 1 m. in length. Mr. Merrill has reason to believe that it occurs also in Celebes, and thus adds another to the already long list of forms common to the Philippines and Celebes. He adds:—"It is now thoroughly established that the Celebes and Moluccan floras are distinctly more closely allied to the flora of the Philippines than is that of any other region, indicating clearly that land connections undoubtedly existed in previous geologic times between the Philippines and the islands to the south and south-east." In addition to the new species, a few species previously known are for the first time credited to the archipelago, and a few changes in nomenclature are proposed.

IN order to facilitate the use of quartz mercury-vapour lamps in dye-fading tests, the U.S. Bureau of Standards has recently measured the radiation of different wave-lengths emitted by a number of these lamps, and has determined its variation with the age of the lamp. The measurements were made by means of a thermo-pile and galvanometer, the various portions of the spectrum being separated by transmitting the radiation through absorbing glasses. The results show that the total radiation of a mercury-vapour lamp decreases during 1000 hours' intermittent use to 30–50 per cent. of its initial value, the radiation of wave-length less than $1{\cdot}4\mu$ decreases during that time from 30 per cent. of the total to about 20 per cent., while that of wave-lengths less than $0{\cdot}45\mu$ decreases from 20 per cent. of the total to about 14 per cent. Messrs. Coblentz, Long, and Kahler, the authors of the paper (No. 330 of the Bureau), attribute this falling off to the blackening of the inside of the quartz tube and the devitrification of the quartz itself.

A RECENT issue of the *Board of Trade Journal* (December 5) records some notable developments of chemical industries in the United States. One instance is the production of nitric acid on a large scale from atmospheric nitrogen. A Government cyanamide-nitrate plant, No. 2, began operations in October at Mussel Shoals, Alabama. The product was utilised for making high explosives, of which the output from this plant is said to be at the rate of about a quarter of a million pounds per annum. Another example is that of potassium compounds. A new unit of a potash plant on Searle's Lake, Southern California, was brought into operation early in November; its employment brings the production of potash by a single company working on this lake up to 140 tons a day.

IN *Helvetica Chimica Acta*, No. 5, there is a short, but suggestive, paper by M. J. Lifschitz on chemical luminescence. Just as with the absorption of light, studies on the emission of light during chemical reactions may prove to be of notable significance in elucidating the connection between radiant and chemical energy and the nature of chemical action. The phenomenon of chemical luminescence is by no means confined to oxidation processes: a good display of light-emission is observed when hydrobenzamide is distilled in a current of hydrogen, although no oxygen is present. Similarly, other reactions indicate that the governing factor is not the total amount of transformed energy, nor the speed of the reaction. The author finds that the organo-magnesium compounds (*e.g.* Grignard's reagent) furnish very convenient material for the study of these and kindred phenomena.

FOR printing-out photographic processes, such as carbon printing, Mr. S. S. Richardson in the *British Journal of Photography* of January 24 recommends the new "Pointolite" lamp. This lamp needs so little current that special wiring is not necessary, and it will allow of, say, six negatives being printed from simultaneously, the exposure being about three-quarters of an hour with negatives of average density. Mr. Richardson also recommends the iron arc if a current of 5 or 6 amperes is available, using iron instead of the usual carbon poles. A lamp so arranged will run sometimes for hours without attention, as the iron burns away very slowly. At a distance of 50 centimetres the exposure required is about twenty minutes. With such "point" sources of light an ordinary glass negative may be printed "reversed" for the single transfer carbon process if ordinary care is taken to prevent troublesome reflections and movement of the negative during the exposure.

A PAPER on electric welding and three others on oxy-acetylene welding were read at the Institution of Mechanical Engineers on January 24. In his paper on electric welding Mr. Thomas T. Heaton says that in his opinion—based upon many years' experience—each known system of welding has its proper sphere, and that probably any given method may be the best in its respectively most suitable application. In the Benardos system of arc welding, direct current is employed at 90 volts and 250 to 500 amperes, according to the thickness of metal. The arc may be $1\frac{1}{2}$ in. to 2 in. in length, and the heat may be spread over a fairly large surface, thus avoiding extreme local stresses. The work is positive to a carbon electrode. In the Kjellberg system a metallic electrode is used instead of carbon. The work is negative to the electrode, so that the natural tendency is to deposit the metal of the positive electrode on to the work. The electrode is coated with a fusible silica flux, which prevents oxidation and insulates the electrode. The arc dissipates this flux, leaving no slag. Generally, the electrodes are of 3/16 in. diameter soft iron wire. Mr. Heaton does not find this system to be satisfactory for plates thinner than 0·25 in. The quasi-arc process, invented by Mr. Arthur Strohmenger, of London, also employs metallic electrodes, and some excellent results are obtained by it. Various coatings may be applied to the electrodes, and may be of such a nature as to supply constituents that are burnt out of the metal in welding. Blue asbestos yarn is especially preferred as a coating in welding iron or mild steel, as it forms a reducing flux, and it may be smeared with a composition such as sodium silicate or aluminium silicate, etc., to vary the fusing temperature of the yarn. Descriptions of some useful testing machines for welds are included in Mr. Heaton's paper.

Messrs. H. K. Lewis and Co., Ltd., have in the press two books by Sir J. W. Barrett, viz. "A Vision of the Possible: What the R.A.M.C. Might Become" and "The War Work of the Y.M.C.A. in Egypt," illustrated. The latter work will contain a preface by Gen. Sir E. H. H. Allenby. *The Library Press, Ltd.*, is bringing out "Practical Shell Forging and the Plastic Deformation of Steel and its Heat Treatment," by C. O. Bower, of Messrs. Armstrong, Whitworth, and Co., Ltd. One object of the work is to show the ways in which hydraulic plant can be profitably employed in peace-time production. *Messrs. J. M. Dent and Sons, Ltd.*, give notice of "New Town: A Proposal in Agricultural, Industrial, Educational, Civic, and Social Reconstruction," edited by W. H. Hughes.

A NEW weekly periodical is about to be published (at 8 Bouverie Street, E.C.4) entitled *Ways and Means: A Weekly Review of Industry, Trade, Commerce, and Social Progress.* Among the editorial features promised in the prospectus issued are Colonial development, expert opinion, industry and money, Government finance, education in relation to industry, industrial administration, reconstruction, art in industry, science and industry, organisation and system, and welfare.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET.—This comet was under observation by Mr. R. L. Waterfield in Cheltenham during January. On January 9 it was a fairly easy object with 3-in., the magnitude being between 9·0 and 9·5; on January 26 it was still visible with 3-in., but much more difficult. The following is a short extension of the ephemeris (for Greenwich midnight):—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
February 6	6 31 57	66 14	0·2219	9·9607
10	6 36 17	66 6	0·2281	9·9815
14	6 41 48	65 52	0·2345	0·0014
18	6 48 20	65 34	0·2410	0·0203
22	6 55 39	65 11	0·2476	0·0381

REID'S COMET (1918*a*).—Circular No. 43 of the Union Observatory, Johannesburg, gives the following positions of this comet made by Mr. H. E. Wood, and the orbit which he deduced from them:—

G.M.T. 1918	R.A. 1918·0 h. m. s.	S. Decl. 1918·0 ° ′ ″
June 13, 1968	9 15 36·52	9 5 55·3
16, 1986	9 16 47·12	11 58 44·8
19, 1982	9 17 4·48	14 40 51·5

$$T = 1918 \text{ June } 5{\cdot}275 \text{ G.M.T.}$$
$$\left.\begin{aligned}\omega &= 194^\circ\ 7'\ 18''\\ \Omega &= 17^\circ\ 49'\ 28''\\ i &= 70^\circ\ 8'\ 41''\end{aligned}\right\} 1918{\cdot}0$$
$$\log q = 0{\cdot}04194$$

Middle place, obs.-comp. R.A. $-11''$, decl. $0''$. The orbit does not show a close resemblance to any in the catalogues. This was the only comet observed in 1918 that did not belong to the Jupiter family.

ASTRONOMY IN THE "TIMES."—We directed attention last week to the important new features in the meteorological reports in the *Times*, and have now pleasure in referring to another scientific innovation which appeared in the issue for February 1. A map is given, on the zenithal equidistant projection, of the stars and planets visible in London at 10 p.m. in mid-February, together with the path of the moon and our satellite's positions and phases at two-day intervals. There is accompanying letterpress by an astronomical correspondent, describing the leading points of interest in the constellations and directing attention to the approaching conjuncion (in 1921) of Jupiter and Saturn, which are now such conspicuous objects. If, as we understand, this is the first of a series of monthly maps and articles, they are likely to lead to a considerable awakening of interest in astronomy on the part of the general public.

THE ENERGY OF MAGNETIC STORMS.—Dr. S. Chapman contributes a paper on this subject to the Monthly Notices for November last. He considers that the sun is the source of energy, and that it is transmitted by streams of electric corpuscles. These ionise and charge the absorbing layer in the atmosphere. The accumulation of charge continues until the electrostatic repulsion overcomes gravity, when the electrified gas is impelled upwards, the atmosphere thus losing both its charge and part of its substance. It was formerly considered that to make the sun the source of energy would involve an inconceivable amount of output from the sun, but under the new theory this is not the case.

EDUCATION AND NATIONAL LIFE.[1]

ONE of the rare and valuable fruits of the sanguinary struggle in which the civilised nations of the world have been engaged since the summer of 1914 is to be found in the awakening of the public mind, at least in this country, to the consideration of the causes which provoked it, and in the disposition to search out the remedies which in the future will make such convulsions impossible of occurrence.

The grave events which still await a satisfactory solution have moved to serious reflection the leaders of the national Church, who two years ago, when the issue of the struggle hung perilously in the balance, felt called upon to ascertain the causes which lay at the root of the great upheaval of civilised humanity and to suggest the remedies. Five influential committees, under the direction of the Archbishops, were appointed to consider the subjects of the teaching office, the worship, the evangelistic work, and the administrative reform of the Church, and, finally, the question of Christianity and industrial problems, in which was included the place and functions of education, with which we are chiefly concerned.

Having regard to the history of educational enterprise in this country, the results of the labours of the twenty-seven able and influential men and women who constituted the last-named committee, with the Bishop of Winchester (Dr. Talbot) as chairman, assisted by the Bishops of Oxford, Peterborough, and Lichfield, together with the Master of Balliol, can only be characterised as revolutionary, so striking is the breadth of view they exhibit, and so complete the admission that education is meant for all the children of the nation without exception of class or condition. Education is "to assist human beings to become themselves . . . is the witness of equality . . . the foundation of democracy . . . and is, in short, the organised aid to the development of human beings in a society." This is the keynote of the admirable report issued by the committee on December 19, 1918, with its well-grounded and clearly stated argument and the fruitful suggestions it offers for the radical reform of our educational methods, incidences, and aims. "There must be," it states, "diversity of educational methods, because there are diversities of gifts. The basis of differentiation should be differences of taste or of capacity, not differences of class or of income. The manual worker needs a liberal education for the same reason as the barrister or the doctor: that he may develop his faculties and play a reasonable part in the affairs of the community." The basis of such an education, it strongly pleads, must be laid in the elementary school, from which all attempts at specialisation should be rigorously excluded, and it further contends that the only sound foundation for technical training is to be found in "the cultivation of mental alertness, judgment, and a sense of responsibility by means of an education of a general and non-utilitarian character."

The report laments the causes which have done so much to hinder the development and diffusion of education during the great industrial epoch, with its materialistic aims and subordination of human faculties to the exigencies, or alleged exigencies, of industry, and among them does not fail to cite the strife and lack of accord of the various religious bodies. It looks to an education, wisely conceived and universally applied, for the effective solution of domestic and international problems by peaceful means. The committee cordially welcomes the provisions of the Education Act of 1918, especially those which are concerned with the physical welfare of children and young persons, and would make mandatory the supply of nursery schools by the local education authorities. It looks forward to the time when the compulsory school-age will be raised to fifteen, and even to sixteen, but recognises that this cannot be expected until the rewards of industry are more equitably distributed and the great working class placed in a position of less anxiety and with the means to enable it to realise a healthy and vigorous life. Fuller opportunities, it is urged, should be provided for the higher education of specially capable children, and the educational system so organised as to raise to a higher level the moral and intellectual standard of the whole people.

Much stress is laid upon the necessity for the better payment of teachers and for more consideration for their status, having regard to their important services to the State. The report strongly approves the proposals contained in the Act for the establishment of compulsory continued education of young persons up to eighteen engaged in employment, but would extend it from eight hours per week to twenty-four out of a working week of forty-eight, or for a corresponding proportion of the month or year according to the special necessities of the case. The main aim of such education should be to develop the physical and mental capacities of the children and to strengthen their character. Even in the continuation schools it is thought desirable that a vocational bias should be given only in the later years of school attendance. It is noted that there is a wide and increasing demand for education of a non-vocational character among adult men and women which should, it is considered, be encouraged in every way possible, and that such opportunities of education should form part of the normal provision of the community.

The report, which is signed by all the members of the committee, quotes with approval Milton's definition of education as "that which fits a man to perform, justly, skilfully, and magnanimously, all the offices, both private and public, of peace and war," but contemplates a much wider application of it, in that all men and women must be included within its scope according to their capacities and powers. A useful bibliography accompanies the report.

[1] "Christianity and Industrial Problems." (London: S.P.C.K., 1918. Price 1s. net.

SEA-STUDIES.[1]

OF the four papers contained in the part of the Bergen Museum Year-book before us, the one of greatest scientific and practical importance is perhaps that by Mr. Torbjørn Gaarder entitled "Die Hydroxylzahl des Meerswassers." The extent of the concentration of hydroxyl ions in sea-water has a great influence on the physiological processes of marine organisms; as Loeb and Herbst have shown, a certain concentration is necessary for the development of echinoderm ova, whether fertilised or not. In a word, the productivity of a sea region depends largely on the concentration of the hydroxyl ions. It becomes, therefore, of importance to study the variations of sea-water in this respect, and to discover the factors on which they depend.

Mr. Gaarder discusses the various methods used for estimating this concentration, which he calls the hydroxyl-number, and enumerates the radicals normally present in sea-water which may affect it. Of these the most important is carbonic acid, which serves as a buffer against the factors that change the hydroxyl-

[1] "Bergens Museums Aarbok, 1916-17." Naturvidenskabelig Raekk 1 Hefte. (Kristiania, 1917.)

number. Thus marine plants (by assimilation) and all marine organisms (by respiration) respectively lessen and increase the concentration of carbonic acid, and so exert considerable influence on the inversely related changes of the hydroxyl-number in any body of water. The carbonic acid is also affected by the carbonates and bicarbonates brought into sea-water from the land or dispersed over the sea-floor. As a result of the successive chemical processes, the hydroxyl-number becomes greater when the sea-water dissolves carbonates from the bottom deposits. Consequently the bottom water should have a larger hydroxyl-number than that of the superjacent layers. Organic life acts on the hydroxyl-number, not merely through the carbonic acid, but also through the carbonates. By removing the calcium and magnesium carbonates from the sea-water it lowers the hydroxyl-number, but gradually, as the organisms die, the organic material and the carbonates are carried down through the deeper layers to the sea-floor. The effect of the atmosphere seems to be confined to readjusting in the upper layers the balance of carbonic acid disturbed by plant assimilation. The chemical changes consequent on an influx of fresh water have as their final expression a reduction of the hydroxyl-number; in other words, the salter the sea, the greater the hydroxyl-number, and the more alkaline the water. The concentration of oxygen in sea-water is, by reason of the vital processes mentioned above, inversely proportional to that of carbonic acid, and therefore stands in direct relation to the hydroxyl-number.

The principles thus worked out by Mr. Gaarder from theoretical interpretation of previous observations have been applied by him to the fjord-waters of western Norway, and have there found both confirmation and extension.

Of the other papers, Mr. J. A. Grieg's inquiry into the age of starfish individuals collected from various localities in the North Sea and North Atlantic is not without its practical bearing. It is found that in any given spot the starfish, like the brittle-stars, are represented only, or in great majority, by the product of a single year. The length of life of a starfish is usually about four years. The species as yet investigated, however, do not appear to include the forms of chief economic importance.

Dr. J. D. Landmark contributes a well-illustrated discussion of the valley system at Dale, in Bruvik; and Prof. G. O. Sars describes, under the name *Urocopia singularis*, a new member of the Copepod family Lichomolgidæ, which, unlike its confamiliars, lives, not near the shore, but in the open sea at some distance from the bottom, and, presumably for this reason, has its caudal rami broadened into oar-blades

RESEARCH ORGANISATION IN INDUSTRIAL WORKS.[1]

Introduction.

NO plans for the future development of industry are now considered complete unless they provide for scientific research, and although this is necessary to a greater or less degree in all industries, in no industry is there such scope for research as in the highly technical electrical industry.

During the past few years there has been a great deal of research directly controlled by or associated with industry. For instance, while universities and technical colleges have in the past conducted research, only a fraction of which has been directed to industrial requirements, the tendency is for an increasing proportion of the research carried out in such institutions to be of an industrial character. Various other laboratories and organisations, together with scientific and engineering societies, have either conducted or financially supported research in connection with their interests.

In a national sense, the Department of Scientific and Industrial Research with its large Treasury grant is endeavouring by the establishment of research associations to develop means whereby co-operative research can be established in various industries, with the initial assistance of Government funds.

Many of these laboratories will provide new industrial knowledge for the common use of those able to make use of it, and, while there is need for them, the individual manufacturer invariably has his own immediate problems, for which he requires special provision directly under his control. In such cases he has to consider whether he should establish his own research organisation or whether he can be efficiently and suitably served by research associations, university or other laboratories. Whatever facilities are available, it is clear that in many instances it is advisable for firms—particularly large ones—to establish research organisations in connection with their own factories.

I.—*Functions of the Organisation.*

The function of an industrial research organisation in its broadest sense is to acquire and to apply all the knowledge and experience which can assist the advancement of the industry, since it is only by the application of new knowledge and experience that progress is made.

It is necessary to draw a clear distinction between research work in pure science and industrial research. Both are essential to industrial progress, the former being directed towards widening the boundaries of knowledge, formulating principles, and revealing relationships that are the raw material of the latter, which is generally directed towards the solution of some specific industrial problem or towards meeting some industrial need

The justification for undertaking research in pure science in a research laboratory associated with an industrial concern lies in the almost inevitable industrial applications which follow rapidly in the wake of a new scientific discovery, and it should be noted that the functions of the man of science, industrial worker, and manufacturer are equally necessary in rendering the ultimate product of a new discovery available to the public. It is questionable from the economic point of view, however, whether the majority of works laboratories should undertake such research, since only a fraction of the new knowledge produced is likely to be of value to one particular works. Much of this work, therefore, must be carried on, as hitherto, by men of science working in private, university, co-operative, or national laboratories. On the other hand, in very large laboratories in complex industries, particularly where special products resulting from discoveries can be manufactured, the undertaking of research in pure science may be of very great value.

Research laboratories partly or wholly supported by industrial firms may be broadly classified according to the particular interests they are intended to serve, as, for example:—

(1) Industrial research laboratories self-contained and serving one particular works.

(2) Central industrial laboratories each forming the scientific focus of an industrial organisation comprising several works, often in different industries, and linked up by control laboratories at the individual works.

[1] From a paper on "Planning a Works Research Organisation" read before the Institution of Electrical Engineers on January 23 by A. P. M. Fleming.

The function of the central laboratory is to conduct research bearing on the manufactures of all the works, and that of each control laboratory is to serve the immediate requirements of the works to which it is attached.

(3) Laboratories planned to serve a wide range of interests in various industries in connection with isolated problems, such as the Mellon Institute of Industrial Research, Pittsburgh, or ordinary commercial laboratories such as that of A. D. Little and Co., Boston.

(4) Laboratories designed to serve the needs of one particular industry working on a co-operative basis, such as the laboratory of the National Canners' Association, U.S.A. The laboratories of the proposed research associations in Great Britain would fall into this class.

(5) State laboratories carrying out researches occasionally of an industrial character, but not necessarily for any particular firm, such as the National Physical Laboratory, the Bureau of Standards, U.S.A., and various university laboratories.

The majority of firms, particularly when commencing research work, find it expedient to combine necessary routine testing with research work, at any rate in the initial stages of development. There are many reasons in favour of this course. Both routine testing and research have much in common, and can make use of the same building and much of the same equipment. The routine testing department serves as a training ground and nursery for some members of the research staff. Further, through the work involved in routine testing the research department is kept in close contact with other works departments.

In the later stages of development, however, and especially in large and complex organisations comprising several works each requiring routine testing, it becomes desirable to establish a separate and, if possible, central laboratory for research work alone.

The laboratories referred to in this paper are considered to comprise both routine and research work, as their combination is the policy most likely to be adopted by manufacturers initiating research organisations.

The functions of such a works research organisation, which involve the arrangement of the department in a number of sections, may be classified thus:—

(1) Testing of raw material supplies and the establishment of a suitable technical basis for purchasing.

(2) Production of new materials or substitutes for those already in use, as, for instance, high-speed tool-steels, improved magnetic sheet-steel, etc.

(3) Investigation of difficulties arising in the manufacturing organisation.

(4) Investigations necessary for controlling and maintaining at their proper level technical processes in manufacture.

(5) Development of new and improved processes and their establishment on a manufacturing scale on most economical lines.

(6) Development of methods for the treatment of factory waste and scrap for by-products.

(7) Investigation of phenomena required in the compilation of fundamental data for designing new apparatus.

(8) Development of new tools, appliances, and methods of testing; improvement and standardisation of those existing.

(9) Investigations of operating troubles and service for customers.

(10) Investigations for the information of financiers of the possibilities of new projects of a scientific character.

(11) Physiological and psychological investigations relating to vocational selection and for determining the most efficient means of employing human services.

(12) Research in pure science.

II.—*Divisions of the Organisation.*

The character of the industry determines mainly the scope and nature of the work to be done and, consequently, the number of sections of the laboratory. In rolling mills, for example, sections devoted to chemical, metallurgical, microscopic, and physical testing are sufficient to meet the main requirements. In the electrical and allied industries the number of sections is perhaps as great as will be found in any industry. These are given below, together with a brief statement of their functions for the general kinds of electrical and mechanical engineering works. In the case of a small works, some sections, such as the workshop, may be provided in the manufacturing departments. It will be noted that some of these sections deal wholly or largely with routine testing, and that they are subsidiary to other sections.

Chemical (Organic and Inorganic).—Co-operating with all other sections and undertaking routine analysis of incoming materials, ferrous, non-ferrous, and organic, for works use, and of materials in process of manufacture, and investigating and standardising speedy methods of routine testing.

Mechanical Testing.—Dealing with all routine tensile, transverse, compression, hardness, and torsion tests on metals and alloys in sheet, rod, or wire form; tests on textile fabrics, papers, fibre and other insulating materials, cements, etc.; destruction tests on assembled parts, and the testing of scale models.

Metallurgical (Ferrous and Non-ferrous).—Responsible for advising on the suitability of metals and their appropriate treatment for use in apparatus and in works equipment and tools; for supervising annealing and other heat treatment processes; for the conduct of investigations for the production of improved metals and alloys; for investigating failures in metals.

Photomicrographic.—Co-operating with the metallurgical and other sections in preparing specimens for microscopic examination and in photographing them.

Electrical.—Responsible for special tests on insulators, conductors, and resistances, both when received and as required during manufacture; for special tests on finished machines, oscillograph investigations, etc.

Magnetic.—Responsible for tests on steel forgings and electrical sheet-steel for permeability, hysteresis, and eddy losses, and on permanent magnets for remanence and coercivity.

Optical.—Dealing with investigations and tests of an optical character, such as the examination of large forgings by optical and X-ray methods; the application of colour testing to routine work, optical examination of screw threads and gauges.

Illuminating.—Undertaking investigations in connection with lamp manufacture.

Physical.—Undertaking all investigations of a physical character not optical or electrical, such as investigations connected with standards of measurement, heat transmission, acoustics, etc.

Pyrometric.—Responsible for the standardisation, repair, regular checking, and supervision of works pyrometers; selection and installation of appropriate instruments where required, and manufacture of spare parts for works use; advising on thermostatic control, methods of high-temperature measurement, refractory materials.

Materials.—Responsible for the standards of size and quality of materials used in the works, and for the acceptance of materials purchased after appropriate chemical, mechanical, electrical, microscopic, and inspection tests. This section draws up specifications to define the limits of variation of sizes and properties of standard materials where required, and secures uniformity of practice throughout the works. It undertakes investigations into defective materials for which special provision is not made.

Technical Processes.—Dealing with the development of new or the improvement of existing processes, particularly those giving trouble in the shops, and requiring the services of expert engineers in a suitable laboratory. Technical supervision may also be exercised over works processes, such as electro-plating, galvanising, sherardising, electric arc, resistance, and spot welding, insulating processes of various kinds, casting, painting and varnishing, and the modes of procedure crystallised in specifications. The development of new processes requires the employment of plant of a semi-manufacturing scale after preliminary small-scale laboratory experiment before the process can be placed in the shops. A most important function of this section is to remove, so far as is practicable, all experimental work from departments the true purpose of which is manufacturing.

By-products.—Responsible for recovering usable products from factory waste and scrap such as oils, metals, and insulating materials. In addition, this section may conveniently be equipped for the preparation of oils, solders, cements, fluxes, special insulating compounds, paints and varnishes where these are special to the works or where they can be prepared more cheaply than they can be purchased outside.

Psychological and Physiological.—Modern methods of engaging employees, particularly juveniles, and of determining a basis for promotion involve the development of psychological tests of intelligence. The evolution of tests of proved validity involves continuous investigation in a laboratory of applied psychology.

Workshop.—For the manufacture of small parts, instruments, etc., and for the preparation of specimens for physical testing, a small workshop is required, fitted with the commoner types of machines, lathes, drilling, milling, and shaping machines, and hand-tools.

Intelligence and Information Section.—It is important in a research organisation to prevent the expenditure of time and money on investigations which have been carried out previously, either inside or outside the organisation, the results of which can be made available for reference. Information of this character may be collected much more economically and thoroughly by a small trained staff than through the promiscuous efforts of the research workers themselves. The information thus collected would form the research library, also under the control of this section. Such a section would serve as a focus and a co-ordinating centre for the research department, and would also facilitate relations between the works and the department and between the department and outside institutions. The section further becomes a repository for the reports of work done in the research department. Too much stress cannot be laid on the importance of keeping adequate records, setting forth not only the causes bringing about the need for research, but also full details of the investigations, the methods employed, the apparatus used, the deductions drawn from results, and a special note of any further researches arising out of the particular investigation reported. It may not be possible to carry out subsidiary investigations at the time, but they may be of sufficient importance to be considered later. In preparing a report, a standard plan is desirable.

Administrative.—Accommodation must be provided in the laboratory building for the staff dealing with the administration of the research organisation. It will be the duty of part of this staff to maintain a proper record of costs of investigations. In some laboratories it is usual for a sum to be set aside for each major investigation; in others, an overall sum is voted each year for the maintenance of the laboratory. Where routine work is done the cost of this may be charged against the works department on behalf of which the expense is incurred. In any case, a systematic record of all costs, stores, breakages, and wages, subdivided according to the various investigations, is of great importance.

III.—*Administration.*

The internal organisation of an industrial research laboratory depends largely upon the nature of the work undertaken. Where it comprises routine testing for works departments the nature and number of the tests carried out form a series of sections each having a departmental chief responsible to the director, and a staff of senior and junior assistants to carry on the work and to provide for continuity in case of transfer or promotion. Where research work of a kind not immediately related to works practice is concerned, each major investigation should be placed in the hands of a competent research man, working with or without assistance, but directly responsible to the director. Where work is combined, as will generally be the case, both methods may be combined.

In either case, the work of the staff is greatly facilitated by regular conferences of the departmental chiefs and research workers, as in this way the progress of work of interest to more than one section can be discussed and the cumulative experience of the whole staff brought to bear on new problems. Overlapping and duplication of work can also be avoided, a possibility which may frequently arise when every part of a problem has to be analysed and different aspects minutely studied by different workers.

IV.—*Staff.*

The most important feature of a research organisation is that of the staff. This country has for centuries produced a succession of distinguished men of science, especially physicists, and at the present time there is no lack of gifted men who are able to extend the boundaries of knowledge. It has, on the other hand, been repeatedly emphasised that there has been a lack of technically trained young men who are able to apply the results of scientific research in industry. The demand was not sufficient to stimulate a suitable supply. The experience of the war period has changed the attitude of industry considerably in this respect, and the inducement offered to university men to enter research work is much greater than hitherto. So far as the limited supply of students permits, the universities have endeavoured to respond, and the scholarships now being awarded, together with the assistance offered by the Department of Scientific and Industrial Research, should do much to encourage students still further. For a considerable time to come, however, the supply of men will be totally insufficient for the needs of industry.

It is an error to suppose that industrial research cannot be carried on without men of genius of the type which has been responsible for many brilliant advances in the past, frequently under considerable personal difficulties and without adequate experimental equipment. Such a type, indeed, is generally not at ease in an industrial works, where research can be reduced to the character of a business, where procedure can be organised on systematic lines towards a clearly defined objective, and where progress can be made by co-operative effort of resourceful, energetic, well-trained, but otherwise ordinary men.

With the exception of those actually engaged in directing research, the staff should comprise comparatively young men and women capable of distinguishing cause from effect, able to observe keenly, and possessing sound technical training, preferably of university standard in the faculty pertaining to the industry they propose to enter, followed by some practical experience. Graduates who have shown during their university career that reasoning capacity, knowledge, resource, and skill in manipulation which comprise aptitude for research might proceed to a works for a period of practical training and then return to the university for a post-graduate course in research before entering the works organisation. Alternatively, students may enter the works for practical experience on concluding a post-graduate course, afterwards being placed in the research department.

In addition to serving as a nursery for research workers, the laboratories should undertake part of the training of all those young men who, in a large organisation are being trained for higher industrial positions, as, for instance, many of those on the designing, commercial, and works management sides. In this way the industry becomes permeated with men having a keen appreciation of the value of scientific method. In connection with the section dealing with works processes, some of these men, promoted possibly from the trade apprentice course, may ultimately be permanently employed. Others would be transferred to the works, where they could utilise their experience in the direction of such processes.

In view of the limited supply of research workers, it is essential that the research department should work in close contact with the educational portion of the organisation now becoming an essential feature in industrial concerns, since the latter would control the selection, training, and promotion of all grades of apprentices. Every possible step should be taken to reveal latent talent, and to provide opportunities for the acquisition of the necessary education and experience.

The universities can only partially complete the training of the staff required for industrial research. This may be illustrated by the procedure adopted at the Mellon Institute of Industrial Research, Pittsburgh, which was founded for the express purpose of conducting researches for manufacturers, the work being undertaken by research fellows selected principally from the universities. These men co-operate closely with the works concerned, and frequently become absorbed into its staff at the conclusion of the research.

The staff of an industrial research organisation, comprising sections as indicated above, will generally include a director, sectional heads, senior and junior assistants, with possibly a number of individual research men responsible to the director. The function of the director calls for special consideration. He must appreciate the possibilities of applying new knowledge to industry to commercial advantage, and be able efficiently to direct specialised research workers, avoiding aimless research having no utilitarian objective. While he requires a wide scientific knowledge to be able to follow intelligently and appreciate the trend of scientific development, he must have, in addition, considerable organising capacity, commercial instinct, and a thorough knowledge of the manufacturing processes of this industry. He must have sufficient breadth of view to be willing to employ expert assistance whenever occasion for this arises.

The sectional heads will, in general, be men of high scientific standing, especially in their particular branch of science. These and the senior staff should be men of university education and training. It is essential that every position in the department should be filled by the best available man for the post, and the research staff should be considered to offer the most highly prized positions, unsuitable men being transferred to other parts of the works organisation.

Conclusions.

No hard-and-fast rule can be laid down as to the amount of money that should be expended on research. Every undertaking must be considered on its own merits, and research expenditure based on the economic needs of the moment and the probable requirements of the future. In many cases it is the impoverished industry which stands in the greatest need of research. Similarly, the small concern, though it may not be able to afford expensive research facilities, can make considerable use of those afforded by universities, national institutions, and private or commercial laboratories. Then, again, the wealthy firm or prosperous industry can maintain an unassailable position through improving by research its methods of production, this being ultimately the only effective method of securing monopoly.

It is an economic error to assume that the best method of increasing profits is, through trade combinations or other means of protection, to increase the selling price. A much more logical method is to bring about the difference between manufacturing cost and selling price by reducing the cost of manufacture, and it is in this connection that the possibilities of research are unlimited.

Apart from its value in assisting economic manufacture, the advertising value of research should not be overlooked. The knowledge that a manufacturing firm employs scientific methods establishes in the public mind a feeling of confidence in the firm's products. Similarly, this may be a by no means negligible factor in favourably influencing investors.

It is to be hoped that firms undertaking research on a large scale will adopt a broad-minded policy in regard to the publication of a great deal of the results of their work. The tendency towards secrecy on the part of most British firms has been weakened to a considerable extent during war-time, when many otherwise rival firms have been engaged upon similar kinds of new work, in which each firm could benefit by exchanging its experience with other firms engaged in the same production. This exchange of experience and information is of the greatest importance in keeping all sections of an industry up to date, and in this way an industry becomes much more potent in international competition, and at the same time individual firms through differences in organisation are no less able to compete among themselves. Moreover, the preparation of work for publication and discussion is of great educational value to a research worker.

In staffing a research organisation, the highest economy is secured by obtaining the very best brains in the various positions, and posts in the research department should be looked upon as those most highly prized in an industrial organisation.

It is to be hoped that the great industrial organisations having well-established research facilities will extend their hospitality freely to those workers in universities and elsewhere to conduct important investigations which they have leisure, but not equipment, to undertake, and that considerable freedom of interchange of ideas and experience with other research organisations will be practised.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. A. Harker, fellow of St. John's College, who held the office of University lecturer in petrology, has been appointed reader in petrology.

Mr. C. R. A. Thacker, fellow of Sidney Sussex College, has been appointed junior demonstrator of physiology until September 30, 1919.

Grants have been made from the Balfour fund of 150*l*. to Mr. C. F. Cooper, of Trinity College, 100*l*. to Mr. J. F. Saunders, of Christ's College, and 100*l*. to Mr. J. Gray, fellow of King's College, in aid of zoological investigations.

The Senate has approved the proposal to establish a Geographical Tripos, and the examination for part i. of this Tripos will be first held in 1920, and for part ii. in 1921. It is recognised that the subject of geography is so extensive and borders upon so many other sciences that to fit a student for geographical research or higher teaching a training is necessary which is of the standard of that required for a Tripos. It is also suggested that such a training would be valuable for the future statesman, administrator, merchant, or missionary. The two parts of this Tripos together will qualify for an honours degree, and part i. will qualify for the diploma in geography, which has proved so useful that it is regarded as important that it should be retained.

LONDON.—Dr. Reginald R. Gates has been appointed for three years, as from January 1, 1919, to the newly established University readership in botany tenable at King's College. Dr. Gates has been demonstrator in botany at McGill University, senior fellow and assistant in botany at the University of Chicago, lecturer in biology at St. Thomas's Hospital Medical School, and acting associate professor of zoology in the University of California. He is the author of "The Mutation Factor in Evolution" and numerous articles in English, German, Canadian, and American scientific journals on various aspects of botanical research.

It has been resolved by the Senate that for the duration of the war, and for a period of twelve months from its termination, the Army education certificate shall be accepted as exempting candidates from the matriculation examination.

The degree of D.Sc. in chemistry has been conferred by the Senate on Dr. A. M. Kellas, an external student, for a thesis entitled "The Determination of the Molecular Complexity of Liquid Sulphur."

SCHOLARSHIPS of the value of 50*l*. per annum, and tenable for two years, are being offered by the Institute of Marine Engineers to young engineers desirous of gaining additional technical knowledge.

A TRAVELLING scholarship of the value of 150*l*. a year, for past or present students of Somerville College, Oxford, is offered by the Mary Ewart Trust. Applications must be received by Mrs. T. H. Green, 56 Woodstock Road, Oxford, by, at latest, March 15.

A CONFERENCE on "Industry and Educational Reconstruction" will be held under the auspices of the Industrial Reconstruction Council on Tuesday, February 11, at 6 p.m., in the hall of the Institute of Journalists, 2 and 4 Tudor Street, E.C.4. The opening address will be given by Mr. F. W. Sanderson, headmaster of Oundle School. No tickets are necessary.

A RESIDENT fellowship is offered by Somerville College, Oxford, for research in classics, mathematics, philosophy, history, economics, or natural science. Its annual value is 120*l*., and the normal tenure is five years—renewable. Particulars are obtainable from Miss Darbishire, Somerville College, Oxford. The latest date for receiving applications and evidence of fitness is March 15.

Two lectures arranged by the London County Council Education Officer will be given next week. One on "Agriculture and Rural Life" will be delivered by Mr. Christopher Turnor at King's College, Strand, W.C.2, on Friday, February 14, at 5.30 p.m., and the other on "Pure Science in Relation to the National Life," by Dr. Arthur Schuster, will be given at the Regent Street Polytechnic, W.1, on Saturday, February 15, at 11 a.m.

IT will be recalled that the Engineering Training Organisation was founded at a meeting held at the Institution of Civil Engineers on October 25, 1917, when a resolution was adopted to appoint a committee, representative of all the chief engineering and educational bodies, to consider the improvement and better co-ordination of engineering training. The committee thus formed has since been making a general survey of the ground to be covered and establishing the broad principles of future work. It has so far been dependent on voluntary assistance, in which the honorary organisers, Mr. A. E. Berriman, of the Daimler Works, Coventry, and Mr. A. P. M. Fleming, of the British Westinghouse Electric and Manufacturing Co., Ltd., have taken a leading part. A stage has now been reached when a paid secretary has become necessary for the future work of the Organisation, and in our advertisement columns in this issue an announcement is made of the offer of this appointment at a salary of 1000*l*. a year. For this important post a fully trained engineer with adequate educational experience seems essential, and we are glad to observe that the Organisation is offering a salary commensurate with the duties of the position. In doing so the Organisation relies on the generous support of leading firms in the engineering industry. There can be no doubt as to the vital importance to the future of the industry of well-organised and efficient engineering training, and we hope that the appeal will meet with an adequate response.

A PETITION is being presented to the governors of the Imperial College of Science and Technology by past and present students of the college urging that immediate steps should be taken to raise the status of the college to that of a university of technology, distinct from the University of London, and empowered to confer its own degrees in science and technology, as is done by the Technical Universities of Germany. At a meeting of past and present students held on January 29 at the Imperial College Union, it was decided, with one dissentient only, to sign and present such a petition. The recognition of the Imperial College as an institution of university rank should, says the petition, be one of the earliest items in the programme of legislative reconstruction. The creation of an Imperial University of Technology appears to be justified, the memorial continues, if it can assist in meeting the ever-increasing demand of industry for men efficiently trained in scientific and technological work. The apathy evinced by many firms in London and elsewhere towards technological research is, the petitioners urge, largely attributable to the absence of an institution devoted to technology bearing the authority and dignity of an imperial university; and they go on to plead that students who have passed through the prescribed courses should be able to start their careers with university degrees equivalent to those granted elsewhere. There will be widespread sympathy with the desire expressed in the petition for the further development in London of research in technology, and for greater facilities for students desiring to pursue courses of work in applied science; but there are likely to be differences of opinion as to the wisdom of inaugurating a separate university devoted only to study and research in pure and applied science. At Manchester, Glasgow, Edinburgh, Sheffield, Bristol, and other places the colleges of technology have in recent years become technical faculties of the universities of their respective areas; and it would seem that similar co-ordination might be possible in a reconstituted University of London with the Imperial College and other London colleges which provide special facilities in applied science, forming a faculty of technology. Also, it may be doubted whether the associateship of the Royal School of Mines—a constituent college of the Imperial College—could be given a higher value than it has at present by being merged in a mining degree of the proposed new university. No doubt these matters have been considered by the promoters of the movement, and will be carefully weighed by the governors of the Imperial College before taking the steps suggested.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—Sir J. J. Thomson, president, in the chair.—Admiral Sir Henry **Jackson** and Prof. G. B. **Bryan**: Experiments demonstrating an electrical effect in vibrating metals. Experiments are described which demonstrate the electrical effect produced by vibration in wires and other metallic bodies, and a method of detecting and recording them by means of searching coils connected to delicate recording apparatus. The diminution of the effect when the surface of a steel wire is rusted is dealt with, in continuation of a paper by one of the authors on the subject of vibrating wires. The inductive effect of a vibrating wire on a neighbouring circuit is mentioned; and this led up to the fact that all metallic bodies experimented with, whatever their shape or material, generate eddy currents, which can be detected in them by using suitable searching coils. That this effect is primarily due to the vibrating conductor cutting the lines of the earth's magnetic field is proved by the experiments, but that there seems to be a residual effect, not at present fully accounted for, which is greater than can be attributed to experimental errors. Details of the tests are described. These have been carried out with wire bridges, tubes, utensils of various forms and materials, and also with Chladni plates.—Prof. T. H. **Havelock**: Wave resistance: some cases of three-dimensional fluid motion. It is shown how to calculate the wave resistance when the surface pressure is two-dimensional and the wave-pattern like that of ship-waves. Certain cases are examined in detail, and the method can be extended to more complex systems. Interpreting some of the results in terms of the related problem of a submerged body, expressions are obtained for the wave resistance of a prolate spheroid and of other bodies.—W. S. **Abell**: Chances of loss of merchant ships. This communication discusses the effect of damage to vessels in respect of chances of loss of bulkheads and the consequent chances of loss of vessels. If the extent of damage be fairly constant, as in torpedo explosions, it would appear that there is an inferior limit to the spacing of bulkheads. Further, as the carriage of cargo is impeded by subdivision, there is an economic reason for calculating the number of bulkheads sufficient for reasonable safety. Such calculation involves the discussion of chances of loss of one or more bulkheads, and of the relation of size of vessel to bulkhead spacing. Assuming that water-tightness is destroyed within radius R from centre of damage, it is shown that where (1) bulkhead spacing $=2R+a$, the "odds on" for loss of *one* bulkhead are $2R/a$; (2) spacing $=2R-a$, "odds on" for loss of *two* bulkheads are $a/(2R-2a)$; and (3) spacing $=R-a$, "odds on" for loss of *three* bulkheads are $2a/(R-3a)$. These results are applied to the case of ordinary cargo-carrying vessels of fixed type, but of varying lengths, with $R=20$ ft. representing longitudinal extent of torpedo damage. Diagrams accompanying indicate that (1) for a given standard of subdivision, decrease of size of large vessels only slightly increases chances of loss; (2) for small vessels, risk of loss is relatively high, and it is doubtful whether any subdivision whatever is effective for vessels below 320-ft. length; (3) safety increases markedly with length of vessel; and (4) intermediate bulkheads are more useful in larger vessels, but may also, in certain cases, increase risk of loss. By suitable assumptions the method may be used to discuss subdivision of passenger vessels exposed to ordinary marine risks.—Prof. W. M. **Hicks**: A critical study of spectral series. Part v.: The spectra of the monatomic gases. This part deals with the series relationships in the second or blue spectra of the rare gases. Not only are the S, D, and F series allotted, but the discussion serves to amplify and sustain the laws developed in preceding parts, and illustrates their value for the purpose of the analysis of spectra in general. Amongst new methods may be mentioned the use of the links, discovered in part iv. of these communications, for the purpose of dealing with lines expected from formulæ or other considerations which lie outside the observed region. Thus, in the case of a wave-number n of a line in the ultra-violet $n-e$, or $n-u$, or *vice versa* if in the ultra-red $n+e$, $n+u$, where e, u are definite and calculable quantities, may be wave-numbers in the observed region and correspond with lines actually seen. In this way it is possible to obtain evidence of the existence and wave-length of lines belonging to the spectrum, although not actually measured. Of importance also in the general theory of spectra is the discovery of summation series. Thus in the case of the ordinary well-known series the wave-numbers are represented as the difference of two quantities $A-\phi(m)$, where m is the order in the series. It is shown that in the case of the F series at least there are, in addition to these difference frequencies, also a corresponding series of summation frequencies given by $n=A+\phi(m)$. For S, D series, such series, if existing, would occur far down in the ultra-violet.

PARIS.

Academy of Sciences, January 20.—M. Léon Guignard in the chair.—H. **Deslandres**: The reform of the calendar. A discussion of a recent proposal of M. Bigourdan, with a summary of previous proposals with the same object. A sketch of an alternative calendar is given.—J. **Andrade**: The minimum number of associated spirals.—R. **Garnier**: The irregular singularities of linear differential equations.—M. **Riquier**: The analytical prolongation of the integrals of certain systems of linear partial differential equations.—G. **Julia**: Some problems relating to the iteration of rational fractions.—P. **Lévy**: Functions of implicit lines.—A. **Guldberg**: The errors of situation of a point. —M. **Mesnager**: A case of simplification of the formulæ of M. Boussinesq.—E. **Belot**: A hypothesis bringing into agreement the vortex cosmogony and the explanation of the peculiarities of novæ and the sun.—G. **Déjardin**: Calculation of the ratio of the principal specific heats of benzene and of cyclohexane by the cyclic method of M. Leduc.—E. **Esclangon**: A new determination of the velocity of sound in the open air. The determination of positions by sound requires a knowledge of the velocity of sound in free air with a very high precision. The numerous experimental difficulties are summarised, and particulars given of determinations made during 1917 and 1918, under varying weather conditions, and at temperatures between 0° and 20° C. The mean value found was 339·9 metres per second in dry air at 15° C.—M. **Horsch**: A method of rapid reduction of potassium chloroplatinate. The salt is dissolved in boiling water, some alcohol added, and evaporated in a platinum crucible on the water-bath. The platinum is deposited as a coherent film on the crucible. Test analyses are given.—Ph. **Dautzenberg** and G. **Dollfus**: A raised beach in the neighbourhood of Saint Malo.—A. **Guébhard**: The cooling of the planetary globes.—P. **Bertrand**: The flora of the coal basin of Lyons.—L. **Joleaud**: Relations between the migrations of the genus Hipparion and the continental connections of Europe, of Africa, and of America during the Upper Miocene period. The author gives evidence which, taken together with the data collected by American geologists, leads to the probable conclusion that during the Upper Miocene period there was land connection between the Old and New World, by means of which Hipparion and other species of mammals could pass from America into Europe and Africa.—C. E. **Brazier**: The influence of the velocity of the wind on the vertical distribution and the variations of the meteorological elements in the lower layers of the atmosphere. The barometric pressure at the ground-level, calculated from observations made on the Eiffel Tower, is lower than the observed pressure. The difference between the observed and calculated pressures increases with the average velocity of the wind.—P. **Guérin**: The development of the anther and pollen of the Labiates.—L. **Moreau**: The architecture of the calcaneum in stereoradiography.—H. **Vincent** and G. **Stodel**: Results of the treatment of gas gangrene by multivalent serum. The serum was obtained from the horse after increasing injections of sixteen races of micro-organisms. Sixty-nine cures out of eighty-one cases were obtained, and of the deaths only eight were the result of gas gangrene.

BOOKS RECEIVED.

The Australian Army Medical Corps in Egypt: An Illustrated and Detailed Account of the Early Organisation and Work of the Australian Medical Units in Egypt in 1914–15. By Lt.-Col. J. W. Barrett and Lieut. P. E. Deane. Pp. xiv+259. (London: H. K. Lewis and Co., Ltd., 1918.) 12*s.* 6*d.* net.

Pre-History in Essex, as Recorded in the Journal of the Essex Field Club. By S. H. Warren. (Essex Field Club Special Memoirs, vol. v.) Pp. 44. (Stratford, Essex: The Essex Field Club; London: Simpkin, Marshall, and Co., Ltd., 1918.) 2*s.* 6*d.* net.

Traité Clinique de Neurologie de Guerre. Par Paul Sollier, Chartier, and Félix Rose, Villandre. Pp. viii+830. (Paris: Félix Alcan, 1918.) 32 francs.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—Dr. W. Wilson: The Movements of the Sun, Earth, and Moon.

ROYAL SOCIETY, at 4.30.—A. Mallock: The Elasticity of Metals as Affected by Temperature.—W. L. Cowley and H. Levy: Vibration and Strength of Struts and Continuous Beams under End Thrusts.—A. Dey: A New Method for the Absolute Determination of Frequency (with a prefatory note by C. V. Raman).

LINNEAN SOCIETY, at 5.—N. E. Brown: (1) Old and New Species of Mesembryanthemum, with Critical Remarks. (2) A New Species of Lobostemon in the Linnean Herbarium.—Dr. J. R. Leeson: Exhibition of Mycetozoa from Epping Forest.

CHEMICAL SOCIETY, at 8.—G. N. White: A Note on the Action of Chloroform on certain Aryl Mercaptans in Presence of Caustic Soda.—J. T. Hewitt and W. J. Jones: (1) The Estimation of the Methoxyl Group. (2) The Estimation of Methyl Alcohol in Wood Distillates and their Concentrates.—P. F. Frankland, F. Challenger, and N. A. Nicholls: The Preparation of Monomethylamine from Chloropicrin.—W. C. McC. Lewis: Studies in Catalysis, Part x. Preliminary Note upon the Applicability of the Radiation Hypothesis to Heterogeneous Reactions.

FRIDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 5.30.—Prof. J. G. Adami: Medical Research in its Relationship to the War.

MONDAY, FEBRUARY 10.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. J. A. Fleming: Scientific Problems of Electric Wave Telegraphy.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Commander Roncagli, Italian Navy: The Adriatic.

TUESDAY, FEBRUARY 11.

ROYAL INSTITUTION at 3.—Prof. J. T. MacGregor-Morris: Study of Electric Arcs and their Applications.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion*: Hon. R. C. Parsons: Centrifugal Pumps for Dealing with Liquids containing Solid, Fibrous, and Erosive Matters.—*Probable Papers*: F. J. Mallett: The Flow of Water in Pipes and Pressure Tunnels.—A. A. Barnes: Discharge of Large Cast-Iron Pipe-Lines in Relation to their Age.

WEDNESDAY, FEBRUARY 12

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Frank Heath: The Government and the Organisation of Scientific Research.

THURSDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—Dr. W. Wilson: The Movements of the Sun, Earth, and Moon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Bt.-Lt.-Col. W. A. J. O'Meara: The Functions of the Engineer: his Education and Training.

CHILD-STUDY SOCIETY, at 6.—Dr. C. W. Kimmins: The Significance of Children's Dreams.

OPTICAL SOCIETY, at 7.—Annual General Meeting.—At 7.30.—Lord Rayleigh: A Possible Disturbance of a Range-finder by Atmospheric Refraction due to the Motion of the Ship which carries it.—L. C. Martin and Mrs. Griffiths: Deposit on Glass Surfaces in Instruments.

FRIDAY, FEBRUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

ROYAL INSTITUTION, at 5.30.—Prof. C. G. Knott: Earthquake Waves and the Interior of the Earth.

MALACOLOGICAL SOCIETY, at 7.—Annual General Meeting.

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NATURE

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

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THURSDAY, FEBRUARY 13, 1919.

THE SCIENTIFIC MAN'S BURDEN.

The Twin Ideals: An Educated Commonwealth. By Sir James W. Barrett. Vols. i. and ii. Pp. xxxii+512 and xx+504. (London: H. K. Lewis and Co., Ltd., 1918.) Price 25s. net.

THESE volumes consist of a series of essays and articles, mostly written originally for the daily Press, on a very large variety of topics, classified under the heads:—Universities; education; medicine; venereal disease; milk and neglected children; town planning and playgrounds; rural life; national parks and the work of explorers; bush nursing; travel and immigration; social; music; electoral reform; Imperial and Australian politics. The author, a Melbourne medical man and consultant, who has taken an active part in the affairs of the Melbourne University, in Australian public and medical questions, and, during the war, in the Australian Army Medical Corps, tells in his preface of the growth of his own faith, away from the original university ideal of leavening the affairs of State by the production of a few well-trained thinkers, towards the twin ideals of Imperial federation and the production of an educated proletariat as necessary for the salvation of the Empire. The first is necessary for the security precedent to any scheme of social betterment, without which the foundations of society are hollow, and the second, the effective education of all adolescents in realities, is forced by the spectacle in Australia of the superficiality and insincerity of popular government. But is not the original university ideal of at least equal importance?

Reflected in these essays is the special need of the younger and vigorous communities of our Empire and America, overflowing with natural wealth, as regards education in an early stage of development, except as concerns the immediate business of life, looking to the universities for guidance and service in their work, rather than in their thoughts, confounding leisure with idleness, apt to consider research, except for utilitarian ends, as snobbery, and culture, unless carefully hidden, as a source of offence to the average man. Whether from these beginnings anything will ultimately follow as worthy of the name of real progress and abiding advancement as has come out of the old universities of Europe, with their monastic origins, has yet to be seen. Instruction in, and the utilisation, dissemination, and popularisation of, knowledge is one thing; no one doubts its necessity and importance; but the getting of knowledge is another. For the latter objective the atmosphere of a monastery would seem to be more suited than the bustle and turmoil attendant upon making adequate returns in social service for pecuniary benefits received, or piously anticipated, which seems to be the ideal, here over-extolled, of what a modern university should be.

No one will want to quarrel with the author for his long and arduous public work in insisting upon the national and social importance of educating the proletariat to the highest attainable point, of disseminating amongst the workers of the world all the science that is of any concern to them in their work. Also, what in older countries than Australia is at least as important is to fill their hours of leisure and release from the monotony of life with the accumulated intellectual spoils of the ages. If, moreover, it be considered that the universities are the best-fitted instruments for this work, let it only be remembered that something more than mere lip-service is due to their original ideals. Let those who want to advance knowledge, and not shout about it, be given back at least the modern equivalent of the monastery, and be left to their work in peace. In point of social service their contribution may prove to be as important as, for example, the running of "more and better live-stock special cars" for the education of the agricultural community. But this is precisely the point that those who want the universities to enter into the life of the community more closely will not honestly and fully concede. "Sporting the oak" to the world, and shutting out the interminable chatter about it, is to them either sheer superciliousness, or else mistaken recluseness, for which closer contact with their fellow-men and acquaintance with the needs, thoughts, and aspirations of the great world are to be prescribed.

In his controversy with Prof. Masson, of which surely the reader ought to have been given both sides, and his article on "The Man of Science" especially, the author seems not to have appreciated the real position, apart altogether from current popular estimation, filled by the creator of new knowledge in the community. The man of science is regarded as in need of reform no less than other people before he can be considered a successful popular leader, which is as true as is the futility of expecting figs from thistles. Elbert Hubbard is quoted to the effect that Nature intends knowledge for service, not as an ornament or for the purposes of *bric-à-brac*. A man of science would, perhaps, not care to dogmatise as to the intentions of Nature, but he would almost certainly regard as a dangerous lunatic anyone who in the twentieth century considered knowledge as ornamental. He might point to the advisability, before cooking a hare, of catching it. The application of science to service, if it is to be regarded as the proper work of the man of science, can only be at the expense of his own work. If the argument merely is that, unless the man who catches the hare can either cook it or catch it cooked, he will never have that position of honour and esteem in the community which is his due, that matter will surely right itself. For the community will not continue to exist, and will not deserve to, in competition with those that are more intelligent, or, at least, better organised. . . . .

The creative type has always been treated as the ugly duckling of the brood, but the creator of new scientific knowledge now holds the material destiny of the world in the hollow of his hand as completely as his prototype in literature, art, music, or abstract thought dominated the future of its mental and moral destiny, though in neither case does their work mature in their own generation. In his reforming zeal Sir James Barrett would storm their last dug-out. The Royal Society is bidden to say good-bye to the relics of medievalism, and to admit to its membership successful organisers of transport, pioneers in public health improvement, and serious statesmen whose obvious services to mankind are at least the equal of those rendered by the dissection of earthworms, the discovery of a capsule on a bacillus, or recondite investigations into rare elements. The Royal Society, like the universities, no doubt has outgrown its original functions, which are being atrophied in competition with the claims of urgent and more practical affairs. Yet if one could go to sleep for fifty years and wake up, the importance of what is being more and more sacrificed might be seen in truer perspective.

FREDERICK SODDY.

NATURAL SCIENCE AND RELIGION.

The Next Step in Religion: An Essay toward the Coming Renaissance. By Dr. R. W. Sellars. Pp. 228. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 1.50 dollars.

WHAT is to be the religion of the future? How far will traditional beliefs be affected by the view of the universe which modern science sets before us? Such are vitally important questions which in the present volume an American author tries to answer. The man of science takes for his postulate the uniformity of Nature. It has served him well, for upon it the physical and biological sciences have been built. But are man's ethical and æsthetic faculties, which dominate human life, conditioned by inexorable law? Could we, if we knew completely a man's history and environment, predict his every action? The man of science is tempted to answer "Yes," and his creed is, then, extraordinarily like the Stoic determinism to be found, for instance, in Marcus Aurelius. Most of us, however, are certain that we have free-will. As we make the admission, the chains of necessity cease to bind us. We find ourselves forced to make an idealist, or spiritual, interpretation of the universe, and many hold Christianity to be the most persuasive consequential position.

Dr. Sellars, in his book, begins by showing that primitive cosmologies, such as are to be found in the Bible, have been finally discredited. Copernican astronomy and the doctrine of evolution have radically altered the setting of Christianity. Next he shows how the study of comparative religion reveals the genesis of much of the myth and ritual legislation of the Old Testament. He then proceeds to discuss the origins of Christianity. He admits Jesus of Nazareth to have been a historical character, but finds in St. Paul's teaching more affinities with the mystery-religions of the Roman Empire than with the faith of which Jesus made Himself the centre. A rapid sketch of the evolution of Christianity brings us to the conflict of science and religion in modern times. Throughout the earlier chapters of his book Dr. Sellars shows wide, though at times superficial, reading; some of his conclusions authoritative scholars would reject. He later argues against miracles, denies the existence of the soul and of personal immortality, finds the problem of evil a fatal obstacle to the Christian idea of God, and ends with a plea for a religion, purged of supernaturalism, which will mean "the valuing of experiences and activities, the striving for their realisation, the loyalty to their call." An obvious criticism presents itself. If man is a product of natural laws which have made him and which he cannot modify, what is the use of his "striving" and "loyalty"? The laws will work themselves out: man is their creature: the end is determined.

The theologian will say that Dr. Sellars has not got to the kernel of traditional Christianity. He chips off bits of the husk and announces that there is nothing inside. Of certain degenerate types of Protestantism it may be that nothing is left when Bibliolatry has gone. But Christian theology is first of all rational. It is founded upon the belief that we can reach absolute truth and upon a determination to succeed in the quest. Arising out of the attempt to find truth are the spiritual interpretations of the universe made by Jewish prophets and by 800 years of Hellenic speculation which began with Socrates and ended with Plotinus. A synthesis of these blends with Christ's teaching, and is constantly associated with the mystical experience of humanity. Modern natural science has nothing to do with the essentials of this massive structure. It can ignore it all; but, in so doing, it will fail to explain man to himself. Dr. Sellars's "religion" is a set of exhortations empirically derived from his social and political environment. We believe that, because its metaphysical basis is defective, it cannot satisfy men, though it may inspire some to live worthily in a democratically organised society.

E. W. BARNES.

THE PASSING OF THE OLD ORDER.

(1) *The Neo-Platonists: A Study in the History of Hellenism.* By Thomas Whittaker. Second edition, with a Supplement on the Commentaries of Proclus. Pp. xv+318. (Cambridge: At the University Press, 1918.) Price 12*s.* net.

(2) *On Society.* By Frederic Harrison. Pp. xii+444. (London: Macmillan and Co., Ltd., 1918.) Price 12*s.* net.

(3) *The Psychology of Conviction: A Study of Beliefs and Attitudes.* By Prof. J. Jastrow.

Pp. xix+387. (Boston and New York: Houghton Mifflin Co.; London: Constable and Co., Ltd., 1918.) Price 10s. 6d. net.

THE only motive for grouping together three such varied books, each important, is that they all in a marked way exhibit an interest which connects them with the special circumstances of the present profound change in the old world-order. This remark may seem to have little significance in regard to (1) Mr. Whittaker's valuable study of the Neo-Platonists. It is not implied, however, that the interest, because circumstantial, is therefore ephemeral. His book appeared seventeen years ago, but the present issue of a new and expanded edition is only one instance of the extraordinary interest which the closing era of the ancient philosophy is arousing to-day. It certainly is not idle curiosity or the impulse towards an eclectic historical research which is drawing so many of our profoundest philosophers to study anew with living interest that last effort of the ancient world. Philosophy is seeking new expression; the old formulæ are unsatisfactory; science has given us a new world-view.

(2) Mr. Frederic Harrison's volume "On Society" is a collection of lectures and addresses, none of recent date or new. It is in another sense that their interest is circumstantial. They are offered us now in literary form because they have served their purpose as propaganda. They are the record of a sustained effort, throughout a long life still capable of vigorous expression, to give humanity a new religious ideal.

(3) Prof. Jastrow's study is called forth by the special circumstances which drew America into the world-war. He has sought to estimate the forces of logic and psychology which combined to bring about this great event.

OUR BOOKSHELF.

Who Giveth Us the Victory. By Arthur Mee. Pp. 191. (London: George Allen and Unwin, Ltd., 1918.) Price 5s. net.

THIS little book is a vivid expression of optimistic theism. It has a strong *note personnel* and an interesting individuality. It is keenly evolutionist and as keenly religious, seeing in all the long processes of becoming the working out of an increasing purpose. It uses Prof. L. J. Henderson's "Fitness of the Environment" in a modernised argument for design. The building stones of the world were all thought out. Water reveals a teleological secret. "Man came into the world to find his house already furnished, his environment exactly what it should be, the necessities of his existence finding their unfailing response in the conditions established through countless ages past." Evolution is not a chapter of accidents, but the unfolding of a great thought.

Mr. Mee has been particularly successful in his picturesque presentation of some of the wonders of the world—the intricacy, the flux, the adaptiveness, and the gradual emergence of mind which was implicit from the beginning.

The great steps in human evolution are poetically described, and man is regarded as fellow-labourer with the Absolute in continuing the task of Evolution. The kingdom of man as striven for by the wisest—and here the author is nothing if not patriotic—is what St. Augustine discerned. Much waste land has to be reclaimed, many marshes have to be drained, there are still many dragons in England; and part of the noble purpose of the book is to show how the lessons of the war may at once enlighten and encourage man in his great endeavour after a fuller embodiment of his highest and most lasting values.

Mr. Mee says in simple words and with some passion what many great thinkers have said learnedly and with more restraint. His book is timely and on the side of the angels, and though we spell some of the words differently we heartily wish it good speed.

Eastern Exploration, Past and Future: Lectures at the Royal Institution. By Prof. W. M. Flinders Petrie. Pp. vi+118. (London: Constable and Co., Ltd., 1918.) Price 2s. 6d. net.

THIS collection of lectures forms a useful and timely book. Prof. Flinders Petrie directs attention to the possibilities of archæological investigation under the new conditions which now prevail in Palestine and in Mesopotamia. His experience urges him to utter a much-needed warning against the system which has already led to much loss of valuable material in Egypt and in Cyprus. He describes in a lucid way the problems on which excavation is certain to throw new light, and he marks out the sites which deserve special attention. Beginning with the later historical period, he describes the beautiful remains of the Christian period in Syria, and the painted tombs of Mareshah, which represent Greek art. Going much further back, the great Scythian migration, which made its centre at Beth Shean, in the valley of Jezreel, deserves special investigation. Jerusalem must not be allowed to become a modern commercial town; a new suburb must be built, and the sacred sites protected and laid open to systematic examination.

Prof. Flinders Petrie gives a lucid sketch of Mesopotamian culture, and he pleads the necessity of a special inquiry into ancient Elamite art. But the main burden of his discourse is to emphasise the urgent need that all future excavation shall be restricted to qualified archæologists, working under rigidly scientific rules, and that it shall not be permitted in the case of enthusiastic, but ignorant, amateurs. Traffic in antiquities, which leads to unauthorised digging by natives, should be sternly prohibited. It may be hoped that the administration soon to be established in Palestine and Mesopotamia will take heed of his advice, which will receive the concurrence of all scientific antiquaries.

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 Effect of Light on Long Ether Waves.

THE curious and important observation made by Mr. Marconi on the basis of experience in long-distance wireless telegraphy exhibits a strange kind of interference between ether waves of very different lengths. The extremely short waves which ionise air interfere with the easy transmission of the long waves which are originated by alternating electric currents, and may conceivably have something to do with the optical opacity of dry haze.

Since many scientific men besides physicists read NATURE, it may be permissible to explain that this is an entirely different effect from the purely localised bands of interference which accompany the superposition of wave motions, and are a matter of simple geometry. In this phenomenon of interference bands there is no destruction, only redistribution, of energy; and there is nothing akin to opacity, whether of the absorbent or the reflective kind. It is, moreover, purely an affair of the ether. Whereas opacity is always an effect brought about by the presence of matter in the path of ether waves, the ions or electrons which are liberated from matter by exceedingly short waves raise a barrier or act as a reflector to extremely long ones. Thus the phenomenon depends on the interaction between free ether and electrified particles immersed in it.

A study of the details of this phenomenon cannot fail to be instructive, and the Radio-telegraphic Committee of the British Association had made preparation for getting facts recorded during the solar eclipse of August, 1914. The war prevented anything being done, but now, as Prof. Fleming—the father of the committee—suggests in NATURE of January 23, another opportunity presents itself in the eclipse of the afternoon of May 29, when the line of totality passes across the South Atlantic from South America to Africa, crossing Ceara, in Brazil, and Princes Island, in the Gulf of Guinea. The astronomers going from this country will have their hands full, but a special group of wireless experts might accompany the expedition if funds were available. It seems probable that assistance might be rendered more readily by the United States than by this country. Prof. Eccles, the secretary of the British Association Wireless Committee, is still too engaged at present with Admiralty work to superintend operations, but the Astronomer Royal has informed him that Dr. Bauer, the head of the Carnegie Institution of Washington, has already made plans for observations on magnetism and atmospheric electricity, and may be planning to take charge of radio-telegraphic observations also. Several months ago Prof. Eccles sent to Dr. Bauer the documents prepared for recording wireless phenomena on the occasion of the previous solar eclipse in 1914, and is again communicating with him. And thus we trust that Prof. Fleming's admirable suggestion will be carried out.

OLIVER J. LODGE,
Chairman of the British Association
Radio-telegraphic Committee.

February 4.

The Aggregate Recoil of Radio-active Substances Emitting α-Rays.

THE November (1918) issue of the *Philosophical Magazine* has just reached us, and I have read with great interest the results of some remarkable experiments by Mr. S. Ratner "On Some Properties of the Active Deposit of Radium." The paper in question deals with the spontaneous transference of active matter from the surface of a plate covered with the active deposit of radium to other objects placed near it.

This effect has been repeatedly observed by workers in radio-activity, and has been attributed (1) to a slight volatility of the active deposit at ordinary temperatures, or (2) to the recoil of a compact cluster of atoms of the active matter when one of the atoms contained in it disintegrates with ejection of an α-particle. To this latter phenomenon I recently gave the name of "aggregate recoil."

Mr. Ratner deals with both possibilities, and arrives at the conclusion that neither of them satisfies the requirements of his results. He states that his experiments "have failed to disclose the nature of the phenomenon."

During the last four years I have been engaged at intervals on experiments of a similar kind, performed with the object of explaining the almost inevitable and unavoidable contamination with polonium of electroscopes and ionisation vessels used in experiments with this substance. In 1915 I made mention of this phenomenon in a paper published in the Communications of this institute (No. 80), and suggested the possibility mentioned under (2) above in explanation of it, although I had, unfortunately, overlooked the fact that Makower and Russ had made the same suggestion in 1910 until I read Mr. Ratner's paper yesterday.

My subsequent experiments with polonium, done for the most part in the summer of 1917, lend strong support to the idea of aggregate recoil as the cause of this "wandering" of the active matter. Inasmuch as I obtained quite appreciable effects with polonium, my results disagree with those of Mr. Ratner; in fact, I have not a single observation which is not adequately explicable in this manner. In No. 113 of the Communications of this institute, which was published in July, 1918, I discussed this phenomenon, and examined the part played by the disintegration of the active foil ("spluttering") due to the bombardment of α-particles. It was found that, in general, much less than 1 per cent. of the total effect is due to the latter cause. A further paper on aggregate recoil is at present in the press, and the work is still in progress.

As I am returning home in the course of a few weeks, I hope before long to publish the results of these experiments in the *Philosophical Magazine*, as well as others of a similar nature done last summer with the active deposit of radium. I beg to mention, however, that, in the light of my own work, I am of the opinion that almost all, if not all, of Mr. Ratner's results are in harmony with the recoil of aggregates of atoms of active matter, as originally suggested by Makower and Russ in explanation of the phenomenon in question.

Like Mr. Ratner, I regard the so-called β-recoil of radium-C from radium-B as a theoretical possibility, which it will be impossible to realise in practice. My reasons for the latter conclusion are contained in my July publication. Dr. Lise Meitner, to whom I mentioned my results last summer, informed me that she no longer believes in the practicability of achieving a transference of active matter by β-recoil. She agreed that the idea of aggregate recoil in the manner above suggested is much more in harmony with the experimental results, and she informed me that Prof. Hahn and herself had never been able to obtain pure radium-C by the postulated β-recoil method.

Before closing this letter, I should like to make mention of the extreme courtesy and kindness shown to me by the Austrian physicists, in particular by Director Prof. Stefan Meyer and Prof. Heinrich Mache, and the other gentlemen associated with this institute, throughout the period of my confinement here since the beginning of the war. They have stood by me through thick and thin, and were never weary in doing what they could to alleviate the strain of life under such unusual conditions. Thanks to their intervention on my behalf, I was given every facility for continuing my research work in the institute, and I have been at all times aided and stimulated in my work by their helpful criticism and encouraging interest.

ROBERT W. LAWSON,
Formerly Pemberton Fellow of the University of Durham.

Vienna Radium Institute, January 5.

Ripple Marks due to High Pressure.

WHILE in London and examining the German guns in the Mall, I came across one with a burst shell in its breech, which is probably a unique curiosity, and possibly of value to geologists and others who are interested in the flow of solids. The shell seems to have burst while being loaded into the gun, and, although it is well opened out, only a small portion is missing. The retained pieces are of interest, for on their inner surfaces they are covered with a large number of small patches of very fine ripple marks. These must have been produced under the intense pressure of the explosion, for it is well known that the insides of shells are turned smooth, polished, and varnished. It is, of course, difficult to say whether a study of these ripple marks will prove of scientific value, but seeing that the gun and its shell are probably exposed to the rain, and as these unique ripple marks may soon corrode away, I should like to suggest that this particular gun and its shell should be protected against further injury by being removed to a geological museum, or, perhaps, to the United Service Institution.

C. E. STROMEYER.

Lancefield, West Didsbury, February 6.

WAR NEUROSES AND "MIRACLE" CURES

IN a London daily paper there appeared recently a dramatic account of a blind Italian soldier suddenly recovering his sight at the door of the church where his bride awaited him. It is not generally known that similar "miracles" occur in this country, and the present writer has been fortunate in witnessing them in considerable number. A brief account of these conditions where the disability is rapidly curable is not without interest, for the war has produced thousands of such cases, and it is a startling fact that many sufferers have been discharged from the Army as "permanently unfit" who might otherwise be doing useful work. To remedy this state of affairs several neurological hospitals have been established, where the study and treatment of war neuroses can be carried out. The recognition that certain disablements are partly or wholly functional is of the greatest importance, for what at first might appear a hopeless condition becomes one that is curable, or, at any rate, can be markedly alleviated. Much original work on this subject has been done by Babinski, in Paris, and by Lt.-Col. Hurst, at Seale Hayne Neurological Hospital, Newton Abbot. Some interesting statistics were recently completed at the latter institution. It was found that the average length of time during which one hundred soldiers had been completely incapacitated owing to disabled legs or arms was eleven months. The average length of time taken to cure ninety-six of these was fifty-four minutes. Of the remaining four, one took one month, two were cured in three weeks, while the fourth required four days before recovery was obtained. The rapidity of the cure was due to the fact that the disabilities were recognised as being not organic, but functional, in character before treatment was carried out.

The origin of a functional disability in a soldier has both a physical and a psychical foundation. Few, if any, cases have been recorded as the result of the fighting in South Africa, 1899–1902. The conditions, however, under which the soldier has fought in the present war have been wholly different.

Trench warfare for prolonged periods under the most adverse climatic conditions, the high explosives causing concussion and burial, profound exhaustion following continued marching and fighting, with all the accompanying revolting sights of war, the strain of responsibility, and the suppression of emotions, are only some of the factors to be borne in mind with regard to the causation of nervous instability. It is worthy of note that there is frequently no history whatever of previous nervous trouble in the soldier who eventually succumbs to the stress and strain of military service. The ordeal through which he has passed tends to make him more impressionable or suggestible, and symptoms of hysteria are liable to supervene.

At Seale Hayne Hospital the term "hysteria" is used to describe any disability produced by auto- or hetero-suggestion which is curable by psychotherapy, by which is meant the treatment by explanation to the patient as to how the abnormal condition was brought about, and how it can be cured. His confidence must be obtained, and the explanation made simple enough for him to understand. This may be followed up, in certain cases, by re-education of muscles, active and passive movements, and persuasion. This definition will be more readily understood if a few cases, or types of cases, frequently met with are very briefly described.

A soldier sprained his ankle and immediately afterwards was rendered unconscious by the explosion of a shell. On recovering consciousness he found he had lost the power in his legs. The concussion or shock had, for the time, paralysed him, and there may have been some actual damage to his spinal cord. The time came, however, when these organic changes had passed away; but the patient was convinced in his own mind that he was permanently injured, and had given up trying to walk properly. Eight months after the onset of his symptoms the loss of power and the drop foot were recognised as being functional in nature, and he was admitted to Seale Hayne Hospital. The condition was explained to him, the muscles of the leg were re-educated, and, with a little persuasion, he was able to run without noticeable limp in a quarter of an hour's time.

A very important class of case is where the soldier has received a bullet wound in the arm or hand, and months later the whole limb may be found paralysed. The hand may be absolutely flaccid, or the fingers have become stiff and rigid, smooth, blue in colour, and even wasted. It was recognised that the disability was out of proportion to the wound, and it was until recently looked upon by many as the result of reflex irritation.

It has been found, however, that these cases yield surprisingly quickly to psychotherapy. The hysterical, flaccid paralysis occurs where the patient is convinced that he is paralysed and has given up trying to use his muscles. There may have been a temporary loss of power with a splint applied for an unnecessary length of time, or the man may have found at first that he experienced less pain if he kept his limb absolutely motionless.

The spastic paralysis of a hand or arm is frequently explained by the patient contracting both his flexor and extensor muscles at the same time. The more he tries to bend his fingers, the more rigid they become. The cause of the apparent trophic changes is due to the altered blood supply brought about by the lack of movement in the former case, and by the continued spasm in the other. It is of interest to note that a hand thrown completely out of action for a year or more may recover its function after a few minutes' treatment.

Many soldiers have been invalided out of the Army with a high percentage of disability as a result of gas poisoning, though many of these are quickly curable by appropriate treatment.

The commonest symptoms persisting after this injury are loss of voice, blindness, and vomiting. Any one of these conditions may be met with many months after the original onset. When a gas shell explodes, in addition to possible injuries from concussion, the gas is liable to set up inflammation of the larynx, intense irritation of the eyes, and vomiting from the absorption of the poison in the stomach. After three or four weeks these symptoms have in most cases disappeared. When, therefore, many months later, the patient is still whispering, the diagnosis of hysteria should at once be considered.

The man during the acute stage of laryngeal irritation has been unable to speak, and rightly may not have attempted to do so. The frequent examinations and the treatment by inhalations and sprays convince him still further that his condition is a serious one; he eventually loses control over the musculature of his vocal apparatus, and is content to whisper. Here, again, with explanation and persuasion, he recovers his voice in a few minutes. Scores of such cases are on record at Seale Hayne Hospital. In a series of sixty-seven consecutive cases it was found that the average length of time they had been under treatment, before admission there, was 205 days—the maximum being nineteen months, and the minimum two weeks. These were all rapidly and permanently cured, the majority taking only a few minutes' time.

Hysterical blindness, following inflammation of the conjunctivæ, is usually caused by spasm or flaccid paralysis of the muscles of the eyelids, just as in those of the arm after a wound. In this condition, however, the mechanism of accommodation or focussing has also been affected. Dramatic cases of cure have been obtained of this condition, and no doubt the one quoted at the beginning of this article was one of these.

The writer was fortunate in seeing a case treated by Lt.-Col. Hurst and Capt. Gill. The patient in question had been blind since 1914 as the result of an explosion in France. At the end of 1918 a doctor eventually recognised the condition as probably functional in nature, and found that the interior of the eyeball was normal. The pensioner, with all the appearance of the typical street beggar, was led up to hospital. As the result of his four years' blindness his hearing and intelligence had been affected, and he appeared extremely dull-witted. Twenty-four hours later this man was scarcely recognisable, for, with the recovery of his sight, his power of hearing also returned, and he appeared alert and happy. In this case the recovery was not instantaneous, for, owing to the length of time his eyes had been functionless, some hours elapsed before his pupil reflex and accommodation acted normally.

Persistent vomiting after gas poisoning may be explained as a hysterical perpetuation of symptoms, and has been found readily amenable to psychotherapy.

The bent back after burial from explosion, where there are no symptoms of organic disease, although the patient persists in walking like an old man with the aid of two sticks, is a condition not infrequently met with. He is convinced he is unable to stand erect, in spite of the fact that there is no curvature of the spine when he is lying in the recumbent position. If persuasion and explanation fail in bringing about recovery, Lt.-Col. Hurst adopts the plan of making the patient lie upon a board with a foot-piece. This is gradually raised to a right angle, and the patient, who finds himself standing in the erect position—the first time, perhaps, for many months—is told to walk forward. The rapidity of the cure, its apparent simplicity, and the surprise of the patient give rise to a situation not without a certain element of humour.

These are only a few examples of war neuroses. Details of treatment depend upon the individual case, but it may be added that the atmosphere of cure that prevails in a neurological hospital is a most powerful factor in recovery. A disabled soldier, coming in contact with others already cured, becomes more hopeful about his own condition, and is the more likely to derive benefit from the treatment adopted.

The object of this communication is to direct attention to the fact that thousands of soldiers, whose disabilities are curable, have been discharged from the Army. Treatment is necessary to enable the pensioner to return to useful civil employment and to save the State from vast expenditure in unnecessary pensions. A. R.

THE PROPOSED UNIVERSITY FOR THE EAST MIDLANDS.

The movement for securing a charter for University College, Nottingham, with the view of making the College the seat of a University for the East Midlands, has been carried further forward an important stage. A large conference of representatives of the counties of Derby, Leicester, Lincoln, Northampton, Nottingham, and Rutland was held in the Grand Jury Room of the Guildhall, Nottingham, on Thursday, January 9. The Duke of Portland, who is the president of University College, took the chair, and the meeting included representatives of the leading civic and educational bodies and institutions throughout the whole area.

The population concerned forms a well-marked geographical unity. It is concentrated, roughly speaking, in an ellipse, with its major axis stretching north and south from Mansfield to Northampton, and its minor axis east and west, with Nottingham at the northern focus. The nearness—half an hour by rail—of Derby, Leicester, and Nottingham will render possible the interchange of students and teachers in a specially economical manner. And the remoter centres of population, such as Lincoln and Northampton, are within easy reach of one at least of the cities already named.

For the present, indeed, University College, Nottingham, and the Midland Agricultural College are the only institutions within the area which, in a systematic manner, provide instruction and pursue research of the highest standard. And the centre of the administration of the University will be at Nottingham. But there are in existence or immediately contemplated a considerable number of institutions providing instruction of a special character, which will become integral parts of the new University, ranging through various degrees of affiliation to the position of schools in the University. Schools of engineering, of lace, and of hosiery will, it is expected, take their respective places on a footing like that of the existing Agricultural College. Plans of a more ambitious character, involving the establishment of colleges of pure science and of arts, are also being developed. The proposed University, therefore, will furnish a type of a federal character in so far as the various schools rise towards, and obtain, recognition.

The movement is thus organic to the soil, and is not an adventitious growth. Amid local differences there is a similarity of social conditions and temperament which will bring a high degree of co-operation within reach. This co-operation may already be found in the joint foundation of the Agricultural College, in the East Midland Educational Union, and in the East Midland District of the Workers' Educational Association. But no more hopeful omen for the realisation of the proposed University could have been anticipated than the unanimity with which, on January 9, the large and representative conference first affirmed the principle in view: "The need for a University providing university and advanced technical education, and promoting scientific research" for the East Midland area, and then, in the second place, outlined the committee which should take the next steps required.

With the proposed foundation, the establishment of a University in each province will be nearly complete. And such is the richness of our English tradition, human and material, that the more recent foundations may look forward to gaining some of that atmosphere which lends a magical stimulus to the studies of our two most ancient Universities. Of the local wealth of which the new University should be the guardian, two instances may suffice, one for arts, and one for science. By a happy accident, not so many years ago, the famous Leicester Codex of the New Testament was rescued from obscurity and careless handling, and is now secure in the muniment-room of the Town Clerk of Leicester.

In Nottingham, for the lack of a proper environment, the remarkable mathematical genius of George Green displayed itself partly in vain. His epoch-making essay, "On the Application of Mathematical Analysis to the Theories of Electricity and Magnetism," was published in Nottingham in 1828 by subscription. In the preface the youthful author expressed the hope that "the difficulty of the subject will incline mathematicians to read this work with indulgence, more particularly when they are informed that it was written by a young man, who has been obliged to obtain the little knowledge that he possesses at such intervals and by such means as other indispensable avocations, which offer but few opportunities of mental improvement, afforded." The hope was vain. To quote the ninth edition of the "Encyclopædia Britannica": "The work of Green, which contained these fine researches, though published in 1828, escaped the notice not only of foreign, but also even of British, mathematicians; and it is a singular fact in the history of science that all his general theorems were rediscovered by Sir William Thomson, Chasles, and Sturm and Gauss." Some years ago, at the instance of my colleague, Prof. E. H. Barton (to whom, himself a local mathematician, the University College is proud to have furnished the opportunities which Green lacked), I gathered from Miss Green some interesting particulars about her distinguished father; and these particulars were forwarded to Sir Joseph Larmor. I cannot imagine a more impressive argument for the foundation of the new University than a careful consideration of the biography of George Green. The traveller to Nottingham from the south can rest his glance on the lower part of a windmill still known as Green's Mill. This belonged to the father of the mathematician. The neighbours still hand on the tradition that the youthful genius worked within the walls of this building.

FRANK GRANGER.

NOTES.

THE KING opened the new Parliament in person on Tuesday, February 11. In his Speech reference was made to proposals to be brought forward for the promotion of a comprehensive scheme of afforestation and to "a Bill for the creation of a new Ministry to deal with public health, with a view to the establishment throughout the land of a scientific and enlightened health organisation to combat disease and to conserve the vigour of the race."

WE deeply regret to announce the death on February 9, in his eighty-fourth year, of Prof. G. Carey Foster, F.R.S., formerly principal of University College, London, and previously professor of physics there from 1865 to 1898. The funeral will be at Rickmansworth Cemetery to-morrow (Friday) at 3.15.

SIR RICHARD THRELFALL, formerly professor of physics in the University of Sydney, has been elected a member 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."

SIR RONALD ROSS, who is consultant in malaria to the War Office, has been appointed honorary consultant in malaria cases to the Ministry of Pensions.

WE regret to see the announcement of the death, at sixty-two years of age, of Prof. R. A. E. Blanchard, professor of parasitology in the faculty of medicine, University of Paris, and author of numerous contributions to zoology, physiology, comparative anatomy, and hygiene, in addition to his works on parasites and parasitic diseases.

THE death is announced, in his sixty-seventh year, of Dr. Rolla C. Carpenter, who occupied a chair of engineering at Cornell University from 1895 to 1917. Dr. Carpenter had been concerned at various times in important engineering enterprises of the cities of Baltimore, Brooklyn, and New York. In 1898 he was president of the American Society of Heating and Ventilating Engineers. He was the author of treatises on experimental engineering, heating and ventilation, and the gas-engine.

NEXT Tuesday, February 18, Capt. G. P. Thomson will give the first of two lectures at the Royal Institution on "Aeroplanes and the Great War." On Thursday, February 20, Prof. H. M. Lefroy will give the first of two lectures on "Insect Enemies of our Food Supplies"; and the second on Thursday, February 27, on "How Silk is Grown and Made." The Friday evening discourse on February 21 will be delivered by Mr. A. T. Hare on "Clock Escapements"; and on February 28 by Prof. J. A. McClelland on "Nuclei and Ions." On Saturday, February 22, at 3 o'clock, the Hon. J. W. Fortescue will give the first of two lectures on "The Empire's Share in England's Wars."

DURING the war the interests of patentees have been adversely affected, and probably none more so than those connected with the chemical industries. Many patentees have been unable to use or develop their patents, whilst in some cases where patents have been granted the mere publication of the grant has been forbidden. Attention is directed to these facts in the *Chemical Trade Journal* of January 25. Representations have already been made to the Controllers of Patents and of Munitions Inventions, but it is suggested that further co-ordinated action is desirable to get the position readjusted. Inasmuch as many holders of British patents have, in the national interest, freely allowed the use of their patents for the period of the war, it is claimed that the "life" of those patents should be extended correspondingly.

WE regret to learn from the *Journal des Observateurs* (vol. ii., No. 12) that M. Jérôme Coggia died on January 15. M. Coggia was born in 1849, and was assistant at Marseilles Observatory for more than fifty years. His colleagues there refer to him as "un astronome actif, habile et consciencieux, et un homme de cœur." He is best known for his discovery of the brilliant comet 1874 III., but he also discovered seven other comets and six minor planets. Another discoverer of a remarkable comet has passed away in the person of Mr. Edwin Holmes, a prominent member of the British Astronomical Association and a regular attendant at its meetings. The comet of short period that he found in November, 1892, was distinguished by two brilliant outbursts, after each of which it expanded rapidly and became difficult to see. It has been re-observed at two out of the three returns that it has made since then, but has never repeated its interesting behaviour of 1892.

THE deaths of the following engineers are announced in the *Engineer* and in *Engineering* for February 7:—Mr. Thomas Wright, late general works manager of the Dowson-Mason Gas Plant Co. He had been recognised for many years as an expert in the construction of coal- and gas-fired furnaces, and was a member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Iron and Steel Institute, and the Faraday Society.—Mr. Edward Cecil Ingleby, who died on January 24 after a long illness, was a director of the firm of Ingleby and Co., Ltd., electrical engineers, and an associate member of the Institution of Civil Engineers.—Mr. George Cuming, who was in his forty-eighth year, and for thirty-two years had been connected with the firm of Messrs. Harland and Wolff, Belfast, latterly as engineering manager. He was a member of the Institution of Mechanical Engineers, and also of the Institution of Naval Architects, and was made an officer of the Order of the British Empire in 1917. He took an important part in the development of the steam turbine for steamship propulsion.

DESIGNERS of motor-cycles have for some time past felt that no adequate means exist to admit of their meeting together for the purpose of ventilating and discussing the difficulties of the many problems with which they are confronted from time to time. In consequence, a representation on the subject was recently placed before the Institution of Automobile Engineers at a conference attended by technical representatives of some of the motor-cycle manufacturing firms. The institution has now arranged for two meetings to be held at the Birmingham Chamber of Commerce expressly for the discussion of points connected with the design of motor-cycles. The first of these meetings will be held on Thursday, February 20, when Mr. D. S. Heather will read a paper entitled "A Survey of Current Motor-cycle Design"; and the second meeting will be held on Thursday, March 20, when Mr. Eric Caudwell will read a paper the title of which is not yet announced. Those who desire to be present at these meetings are invited to communicate with the secretary of the institution, 28 Victoria Street, Westminster, S.W.1.

INFLUENZA is now epidemic in Australia, is spreading in Victoria and South Australia, and is attended with a considerable mortality. In South Africa influenza is stated to have caused the death of 11,736 Europeans and 127,000 "coloured" and natives. With regard to the nature of the virus of influenza, it has been surmised of late that the influenza bacillus of Pfeiffer may not be the causative organism, but that an excessively minute, "filterable" micro-organism may be present, and evidence in favour of this view has been brought forward by Major-Gen. Sir J. Rose Bradford and Capts. E. F. Bashford and J. A. Wilson (*Lancet*, February 1, 1919, p. 169). They found present minute, rounded, coccus-like bodies measuring 0·15μ to 0·5μ in diameter, Gram positive, anaerobic, resisting heating to 56° C. for thirty minutes, and passing through Berkefeld N and V filters and a Massen porcelain filter. The organisms have been isolated from the blood, sputum, and pleural fluid, and obtained in cultivation (method not stated). The cultures inoculated into animals produce illness in guinea-pigs and monkeys with pneumonia and hæmorrhages. Similar experiments have been carried out with trench fever and nephritis, and organisms of the same type have been isolated in these diseases, cultures of which on inoculation produce respectively trench fever and nephritis. In the case of trench fever, the same organism was isolated from infected lice.

WE have received the first annual report of the Industrial Reconstruction Council, a purely educational corporation, with Sir Wilfrid Stokes as president and Mr. Ernest J. P. Benn as chairman. Prof. W. Ripper, Vice-Chancellor of the University of Sheffield, is treasurer and Prof. A. W. Kirkaldy, of Birmingham, a member of the executive, so that education of university grade is well represented. The object of the council, which was established in December, 1917, is to contribute to the solution of the problem of labour unrest by supplying information on industrial economics alike to employers and employed by means of lectures, conferences, and the distribution of printed matter, and, in particular, to make widely known the proposals of the Whitley Committee with reference to the self-government of industry by means of industrial councils and interim committees, and to urge the organisation of all trades, both employers and employed, so as to make the formation of industrial councils possible. To this end the council has held public meetings in the largest cities, and sent lecturers to address trade and other societies in more than forty centres. Some of the larger gatherings have been addressed by the Minister of Reconstruction, the Minister of Labour, the President of the Board of Trade, and the chairman of the Department of Scientific and Industrial Research. Since last September fortnightly lectures have been given on Wednesday afternoons in Saddlers' Hall, kindly lent by the Saddlers' Company, and fortnightly conferences have been held on Tuesday evenings in the hall of the Institute of Journalists. Sixty thousand copies of the council's pamphlet on "Trade Parliaments" have been distributed, besides much other literature. The offices of the council are at 2 Tudor Street, E.C.4.

THE Lieutenant-Governor of Bengal, in unveiling a bust of Sir Leonard Rogers at the Calcutta School of Tropical Medicine, paid a generous tribute to the work performed by that eminent physiologist. To him is due the successful treatment of the disease known as kala-azar, long a scourge in the Assam Valley. In connection with this investigation, he initiated a new treatment for dysentery, and discovered a vaccine used in cases of sprue. Sir Leonard Rogers's industry in these researches was immense. Besides important books, he has published more than 150 scientific papers, and he has never hesitated to announce to the world the results of his labours. To Sir Leonard Rogers the Calcutta School of Tropical Medicine owes its establishment, and no place could be more appropriate for the location of the bust of a scientific worker who has made important discoveries leading to the mitigation of various forms of disease.

IN a review on the subject of alcohol, based upon the report of the Central Control Board, Dean Wace records his personal impressions. He says:—"For some years I was engaged in writing leading articles at night, and when I returned home, between three and four o'clock in the morning, my brain was too excited for sleep; but a crust of bread and a little claret would give me prolonged and refreshing repose. My experience, in fact, in a hard-working life which has now extended to eighty-two years, has been that alcohol is bad to work upon, but invaluable to rest upon. It has enabled me, indeed, sometimes to do literary work at night after being engaged a great part of the day on the duties of my profession; but only on condition of my interposing a sort of semi-night between the two employments, by two or three hours' rest after dinner, with a good nap. There may be many modifications of this kind in the use of alcoholic drinks; but they are always mere variations of the principle which, after the verdict of this scientific jury, may now be taken to be firmly established—that the chief effect and use of alcohol is to promote rest, and the reinvigoration which rest brings" (*Quarterly Review*, No. 458, January, p. 63).

IN the issue of *Scientia* for September, 1918, Prof. Fraser Harris publishes an interesting paper directing attention to the functional inertia and momentum of living matter. By this Prof. Harris understands those properties in virtue of which the effect of a stimulus is not at once manifested, nor does the result cease immediately on cessation of the stimulus. The statement applies in a certain sense to all matter, and the key is doubtless, as the author points out, the inertia of the carbon atom. But it seems doubtful whether it is justifiable, or even illuminating, to place this property as an antagonist to that of excitability or the capacity of responding to the action of an external force. There seems to be a suggestion of the ancient confusion of thought in which inertia is regarded as a force. The manifestations of it, however, play an important part in physiological phenomena.

INTERESTING "Notes on Myriapoda," by Hilda and Graham Brade-Birks, furnish the Dartford Naturalists' Field Club with an occasional paper "reprinted from the *Lancashire and Cheshire Naturalist*, September and October, 1918." The authors assign to Kent twelve species of Chilopoda, of which four are luminous, and eight species of Diplopoda. Their notes on synonymy would have been more serviceable had they appended dates to the genera and species instead of relegating them to the concluding bibliography. There, too, the "Systema Naturæ" (printed "Systema Natura") is undated, as though there were only one edition of that famous work. In these days of expensive printing the enumeration of ever so many places where specimens have been captured could well have been spared, and the space devoted to concise definitions of the various items of classification. This would probably have been an easy task to these capable writers, and would have gone far to "prove an incentive to further faunistic work in the neighbourhood" in accordance with their express desire. Their list of authorities omits Leach's article in the "Edinburgh Encyclopædia," vol. vii., which carries the date of his *Cryptops hortensis* and his *Lithobius variegatus* back to 1813 alike for each genus and species.

THE Egyptian Government has recently published a useful booklet to supplement its circulars issued in connection with the administration of the law for the protection of birds beneficial to agriculture. This has been prepared by Capt. Flower and Mr. M. J. Nicoll, the director and assistant director of the Zoological Service. It treats of the principal birds protected, and gives their English, French, Arabic, and scientific names, their local status, and their size and coloration. In eight helpful coloured plates are depicted twenty-four of the forty species dealt with. Measures for the protection of these birds are especially necessary in Egypt on account of the ravages of hosts of insect pests, the chief natural enemies of which, the insectivorous birds, are, unfortunately, correspondingly scarce. To afford this protection a law was promulgated in 1912, and circulars have since been widely distributed giving, in various languages, the names of the scheduled species, forbidding their destruction, capture, sale, etc., and intimating the penalties to be inflicted upon those who contravene the Act. That these measures have met with considerable success as regards some species is well indicated in the case of the buff-backed heron, which is a great destroyer of locusts and other noxious insects. This bird had, previous to the protecting law, become reduced to a single colony; now it has greatly increased in numbers, and is to be found in many parts of the Delta. It is to be regretted, however, that the law has not been strictly observed as regards the smaller insectivorous birds. This seems to be, to a considerable degree, due to the fact that the permission granted under licences for the killing and capture of unprotected birds has been frequently misapplied for the destruction of protected species. These illegally acquired birds, after being denuded of their feathers, to render their identification difficult or impossible, are often exposed for sale. The final paragraph of the introduction to this interesting booklet is devoted to an earnest appeal to all who have the welfare of agriculture at heart to make every effort to protect the scheduled birds in the interests of the staple industry of the country.

MR. C. RAUNKIÄR (*Botanisk Tidsskrift*, 36 Bind, 3 Hefte, 1918) describes some experiments to determine to what degree the time of leafing is a constant character in the beech. In the case of marked individual trees, the relative periods of leafing proved to be constant in three successive seasons. Fruits of these trees were collected and sown, under uniform conditions, in the botanic garden at Copenhagen, and the tables of results show a striking correspondence between the mother and descendants with regard to leaf-time, and indicate that early or late leaf-time in the cases in question is genotypically determined. On the hypothesis that the genotypic basis of, for instance, very early leaf-time is a single factor, and either dominant or recessive, the author concludes that it is probably most reasonable to assume that the mother-plant is heterozygous with regard to the factor for leaf-time, and in that case very early leaf-time must be dominant. But it is scarcely likely, the author suggests, that the matter is so simple, and leaf-time is probably, in each individual case, conditioned by a complicated combination of genotypic factors, which at one time can operate in the same direction, and at another may counteract each other. The experiments show that there are not only early and normal beeches, but also a series that varies with regard to leaf-time from very early to very late. The most important point is that *Fagus sylvatica* comprises sub-species, isoreagents, that differ with regard to leaf-time.

THE value of quinine in combating malaria and other tropical fevers makes it most important that the Empire should be sure of adequate supplies of cinchona bark, from which the drug is obtained. An article on the future of the trade in cinchona bark in the Bulletin of the Imperial Institute (vol. xvi., No. 3) directs attention to a somewhat unsatisfactory state of affairs. It appears that for some years past the Dutch East Indies, and particularly Java, have had almost a monopoly in the production. In the years 1911–13 the average annual production of cinchona bark in Java was 22,880,000 lb. out of the world's total production of about 25,000,000 lb. In India, where the area under cinchona fluctuates a little, but, on the whole, decreases, the annual production is about 2,000,000 lb. Ceylon, which some thirty years ago had an annual output of more than 13,000,000 lb., has now practically ceased to be a producer. Eighty per cent. of the world's supply of this bark now finds its way to market at Amsterdam. The article contains many statistics relating to the trade in quinine. It is enough to mention that India's annual consumption of quinine is about 145,000 lb., of which about half is produced in the country and half imported. The home production of bark is inadequate to meet the demand for quinine in India. It would thus appear that a great part of the Empire's supply of quinine has to be imported from foreign countries. This shows the need for extending the cultivation of the cinchona tree under conditions which result in a maximum yield of quinine in the bark. The article concludes with some notes on experiments in this direction in St. Helena and (German) East Africa.

THE Journal of the Scottish Meteorological Society, with its tables for the year 1917, contains two or three communications of especial interest to meteorologists. "The Upper Air: Some Impressions Gained by Flying" is dealt with by Capt. C. K. M. Douglas, and forms the subject of an article in our pages this week. "Ground-Ice" is the subject of a communication by Dr. John Aitken. The paper is somewhat controversial, and deals chiefly with a communication by Mr. A. Watt on the same subject printed in a previous issue of the Journal. "The Climate and Meteorology of Antarctic and Sub-Antarctic Regions" is abridged from an address given by Mr. R. C. Mossman by request of the councils of the Royal Society of Edinburgh and of the Scottish Meteorological Society. The author states that our knowledge of Antarctic regions is limited chiefly to observations during the last twenty years, whilst prior to this our knowledge was confined exclusively to observations derived from summer voyages. With reference to the general circulation of the atmosphere, it is shown that easterly winds are commonly experienced in sub-polar regions associated with travelling cyclonic areas situated to the northward. In this connection reference is made to the National Antarctic Expedition, 1901–4, and to the daily synchronous charts throughout the four years drawn from the observations of the expedition augmented from other sources. Upper-air observations made with kites and balloons are said to be scanty, and most of the facts available are from the movements of high clouds. Pilot-balloon ascents, however, have at times shown that the stratosphere was as low as 4½ miles.

LIGHT-FILTERS made of a new yellow dye have just been introduced by the Eastman Kodak Co. Picric acid being too unstable (filters made with it turn brown), and a more sharply cut absorption being sometimes desirable than that given by "filter yellow," Messrs. Mees and Clarke sought for a dye that would fulfil the desired conditions. They found that glucosephenylosazone gives almost as good absorption of the ultra-violet as "filter yellow," as well as a sharper cut on the other side of the band, and is satisfactorily stable. The actual derivative used, the osazone itself being insoluble in water, is the sodium salt of glucosephenylosazoneparacarboxylic acid, and for convenience they call it "Eastman yellow." The filters are made of three densities, one specially for aerial photography, and this has been adopted by the American forces. Further details with absorption curves are given in the *British Journal of Photography* for January 31.

AN article on metric measurements appears in the January issue of *Cheap Steam*, a periodical issued by the well-known engineers, Messrs. Ed. Bennis and Co., Ltd. From the point of view of the writer of the article, the greatest advantage to be derived from the adoption of the metric system is the enabling of manufacturers to compete on more equal terms with foreign rivals in the world's markets. Inability or unwillingness of the British manufacturer to estimate for overseas clients in terms which they understand has lost many a contract to this country. One secret of Germany's rapid progress as a foreign trader was the promptitude with which she adapted her business methods to the habits and customs of the various nations with which she was anxious to deal, and she never annoyed and puzzled possible customers abroad by quoting quantities and prices in terms which they did not understand. In 1864 an Act was passed to render permissive the use of the metric system; in 1897 another Act was passed making the use of the system optional. The time is now ripe for making it compulsory.

THE influence of the state of the atmosphere on the level of the sea has been very variously estimated, particularly as regards the relative importance of barometric pressure and wind. At one of the recent British Association geophysical discussions Col. Sir C. F. Close reviewed the subject, and described certain new data obtained by the Ordnance Survey (*Geographical Journal*, July, 1918). These showed that at the observation points chosen, on the coast of the Atlantic Ocean and the North Sea, the sea-level responds almost immediately to barometric variations. A rise or fall in the height of the mercury is associated with a fall or rise of sea-level of 13·5 times the amount (equivalent to the variation in a water-barometer). Changes of level due to winds cause some fluctuation in individual estimates of the ratio (from 7 to 20, roughly), but not sufficiently to mask the close connection between sea-level and barometric pressure. In a narrow, land-locked sea, however, it might be expected that the wind would have relatively greater influence, and this is confirmed by a recent study of the Baltic sea-level by Rolf Witting (*Öfv. af Finska Vet.-Soc. Förh.*, vol. lix., A, 13, Helsingfors, 1917). The purely hydrostatic effect of a gradient of barometric pressure over any region is to produce an opposite slope of the sea-surface. But such a distribution of atmospheric pressure is usually accompanied by winds directed along the isobars, with the higher pressure on the left (in the northern hemisphere). This tends to heap up the waters with a gradient perpendicular to the former one, and in the Baltic this slope appears to be about 1·8 times as great as the hydrostatic slope. The resultant gradient is rather more than twice the latter, and is inclined to it in azimuth at about 55°.

THE largest plate-rolling mill in the world is described in an illustrated article in *Engineering* for January 24. This mill belongs to the Lukens Steel Co., of Coatesville, Pennsylvania. It is a four-high reversing type mill, 17 ft. wide on the rolls, and is capable of rolling plates up to 16 ft. in width, and circular plates a few inches wider. It is built on the principle of the two-high reversing plate-stand used in the British Isles, with the modification that the two finishing rolls are backed by two large supporting rolls. The latter rolls stiffen the mill and prevent springing of the operating rolls when rolling wide, thin plates, thus ensuring uniform thickness in the finished product. There are two 34 in. diameter by 204 in. working-face operating rolls of chilled iron with 27-in. necks, weighing about thirty tons each, and two 50 in. diameter backing rolls of cast-steel with 36-in. necks, weighing about sixty tons each. The mill stands about 40 ft. from the top of the screw-cover to the bottom of the shoes. The screw-down rig is of the well-known worm and worm-wheel design, and is driven by two 150-h.p. motors, one on each housing. The mill is driven by a twin tandem compound engine, having cylinders of 46 in. and 70 in. diameter by 60 in. stroke, and is fitted with a jack-shaft and a gear ratio of one to two, which renders it capable of giving an enormous torque. Mechanical tables are provided so arranged as to do away with hand-labour wherever possible.

MESSRS. LONGMANS AND CO.'s new list of announcements contains many books of scientific interest, some of which have already been referred to in these columns. Others are:—"Applied Aero-dynamics," L. Bairstow, illustrated; "Aeroplane Structures," A. J. S. Pippard and Capt. L. Pritchard, with a preface by L. Bairstow, illustrated; "Corrosion and Decay of Metals," Prof. C. H. Desch; "Lead and its Compounds," Dr. J. A, Smythe; "Boiler Chemistry," J. H. Paul; "The Rare Earth Metals," Dr. J. F. Spencer; "Chemical Affinity and Chemical Equilibrium," Dr. H. S. Taylor; a new edition of "Osmotic Pressure," Prof. A. Findlay; "Ships' Boats: Their Qualities, Construction, Equipment, and Launching Appliances," E. W. Blocksidge; and "Efficient Boiler Management, with Notes on the Firing of Coal-fired Reheating Furnaces," C. F. Wade. Messrs. Longmans also have in hand the third edition of "British Birds," A. Thorburn, illustrated, the first two volumes of which have been published. Vol. iii. is promised for March, and vol. iv. for April.

MR. F. EDWARDS, 83 High Street, Marylebone, W.1, has just published Catalogue No. 386 of books, manuscripts, and engravings relating to India and Ceylon. It contains many rare works and a number of books of scientific interest, *e.g.* a complete set of the "Catalogue of the Birds in the British Museum," 27 vols.; Hooker's "Illustrations of Himalayan Plants"; Capt. W. V. Legge's "History of the Birds of Ceylon"; and vols. i. to v. of Moore's "Lepidoptera Indica." Mr. Edwards has also for disposal the Sanskrit library of the late Col. G. A. Jacob, comprising about 700 vols.

MESSRS. DULAU AND CO., LTD., have just issued from their new address (34 Margaret Street, Cavendish Square, W.1) Catalogue No. 74 of some 1200 books on botany, agriculture, and zoology which they have for disposal. It gives particulars of many rare editions of works dealing with the subjects referred to, and should be of service to many readers of NATURE. A feature of the catalogue is many of the earlier volumes of the British Museum Zoological Catalogues and Lists.

OUR ASTRONOMICAL COLUMN.

The Pulsation Theory of Cepheid Variability.—The Monthly Notices for November last contain a paper on this subject by Prof. Eddington, who selects fourteen Cepheids, the light-curves of which are well known, to test the theory. The absolute magnitudes are deduced from the periods, using a diagram given by Mr. Shapley, and the effective temperatures and densities from a former paper of his own. Prof. Eddington finds that all the stars are in a gaseous state throughout their volume except the two of lowest absolute magnitude; he connects this with the fact that Mr. Shapley's diagram shows a linear relation between period and magnitude for the brighter stars, but a curve for the fainter ones. The radius of Y Ophiuchi, the brightest star on the list (abs. mag. -4), is given as 42,000,000 km., the mass being thirteen times the sun's; on the average, the semi-amplitude of the pulsation is 1/13 of the radius. Assuming an effective temperature proportional to the fourth root of the luminosity, the semi-amplitude of the temperature fluctuation is 1/12 of the whole. Prof. Eddington also deduces that with period 4·5 days should correspond spectral type F8½, and with period 30·8 days type G3½. These deductions are in fair accordance with Mr. Shapley's latest observational results.

Prof. Eddington directs attention to an erratum in his former paper on the radiative equilibrium of the stars, the radiation pressure being taken at four times its true value. The error may be corrected by multiplying the adopted molecular weight by 2·8. It will, however, make the calculated duration of the Giant stage even shorter than before.

Calcium Clouds in the Milky Way.—The February *Observatory* contains a letter on this subject by Mr. J. Evershed. The suggestion was first made in the case of δ Orionis that it was surrounded by such clouds, since the H and K lines did not share in the orbital motion. Mr. Evershed now shows that the same is the case in Nova Aquilæ, Nova Persei, and Nova Geminorum (2), and quotes five other stars in Aquila, Scorpio, Perseus, and Orion showing the same phenomenon. In all cases the radial motion indicated by the H, K lines agrees within some 4 km./sec. with that due to the sun's motion (assumed 20 km./sec., towards 18h., $+30°$). Hence the calcium clouds would appear to be practically at rest with respect to the star system, the attraction of the stars upon them being, perhaps, nearly balanced by radiation pressure. It will be remembered that the Orion nebula also appears to have no line-of-sight velocity other than that due to the solar motion.

Mr. Evershed notes that the phenomenon is rendered easier of detection in novæ owing to the large displacement of the H line in the star's own spectrum, which separates it from that due to the cosmic cloud. The latter is seen as a fine absorption line on the broad bright hydrogen band H_ϵ of the nova's spectrum.

A "New Navigation" Method.—In "Notes on the Working of the 'New Navigation'" (Cairo: Government Press, 1918), Dr. John Ball gives a convenient method of calculating altitude from hour-angle (h), latitude (l), and declination (d). First find an auxiliary angle M from the equation

$$\cos^2 M = \cos^2 \frac{h}{2} \cos l \cos d.$$

Then

$$\sin^2 \frac{Z.D.}{2} = \sin\left(M + \frac{l \pm d}{2}\right) \sin\left(M - \frac{l \pm d}{2}\right).$$

Use upper sign for l, d *same* name, lower for *contrary* name. Dr. Ball points out the advantages of the method both for navigation and land-surveying. He might, however, have alluded to the very useful "Altitude Tables" of his namesake, the Rev. F. Ball, R.N. (London: J. D. Potter), which give the altitude, without calculation, for every degree of l, d, h to an accuracy of 0·1′ (nearly).

THE WORK OF THE GOVERNMENT LABORATORY.

FROM the recently issued annual report of the Government Chemist on the work of the Government Laboratory (Cd. 9205), it appears that the total number of samples examined during the year 1917–18 was 200,453.

Work for several new departments, including the Air Board, the Ministry of Food, and the Coal Controller's establishment, was undertaken during the year. The aggregate number of samples analysed, however, was some 58,000 less than in the preceding twelve months. This decrease is attributed chiefly to a falling-off in the work required for the Customs and Excise Department. Following upon diminished imports, fewer samples of imported goods were taken for analysis; and war-time restrictions affecting the home consumption of wines and spirits similarly caused a reduction in the amount of analytical work required.

On the other hand, much of the laboratory activity has been devoted to matters arising directly out of war conditions. Among points of special interest may be noted the analytical control over the quality of foodstuffs and medical supplies for the fighting forces, and over the composition of metals employed in naval and aerial constructional work.

More than 20,000 samples of foodstuffs were examined in connection with the feeding of the Expeditionary Forces. This work was carried out partly at the chief laboratory, and partly by officers of the laboratory stationed at the various supply bases. The quality of the supplies was controlled by first examining samples tendered by contractors, in order to ascertain whether the conditions of the specifications were complied with. Specimens of the foods actually delivered were afterwards analysed, to ensure that the deliveries compared satisfactorily with the selected "tender" samples. Most of the analyses were made on specimens taken from contractors' deliveries in course of transit to the Forces, the goods being detained until the report upon their quality had been received by the Army authorities. A salutary check was thus in operation against any tendency to unfair dealing.

The scientific public, and also the general public, would no doubt be interested in knowing whether any adulterations or other attempted impositions were discovered, but on this point the report of the Government Chemist is silent. Still, it may safely be assumed that the systematic examination of supplies would in any case be a strong deterrent against attempts to substitute inferior articles. It may be taken for granted, therefore, that the laboratory control has both conduced to the efficiency of the fighting forces and effected economy of public money.

For the Army Medical Department 960 samples of medicinal articles were examined. As might be expected, these consisted largely of anæsthetics. It is scarcely necessary to point out that the comfort, and often the life, of wounded soldiers under anæsthesia would depend upon the quality of the anæsthetic substance used; and it is good to know that steps were taken by systematic chemical analyses to ensure the provision of satisfactory supplies. The remainder of the medical articles examined consisted of phenacetin, "aspirin," and miscellaneous products such as quinine preparations and alkaloids for hypodermal injection or ophthalmic uses.

The constructional activities of our naval and aerial Services are reflected in the report by the remark that 8921 samples examined for the Admiralty consisted largely of metals analysed for the Engineering Department, whilst from the Air Board more than a thousand specimens were sent—chiefly alloys. A sample of a so-called substitute for platinum examined for the Ministry of Munitions proved to be an alloy of nickel, chromium, and tungsten.

In connection with contraband trading, numerous questions were submitted to the laboratory by the War Trade Department, the Foreign Office, the Treasury Solicitor, and the Admiralty Marshal. For the two last-named officials 396 samples were analysed in connection with materials seized as prize, or which were the subject of Prize Court proceedings. They included such varied substances as thorium nitrate (used in making gas mantles), oils, colours, resins, drugs, and soap.

Space does not allow of more than a passing reference to the analyses made for the Board of Agriculture, Home Office, Post Office, Board of Trade, and other Departments. The report shows that a large amount of chemical work, having prime importance for Government administrative requirements, has been accomplished during the period in question.

MAGNETIC OBSERVATIONS DURING A SOLAR ECLIPSE.

THE September issue of *Terrestrial Magnetism and Atmospheric Electricity* is mainly devoted to magnetic observations taken during the total solar eclipse of June 8, 1918. Dr. Bauer, the head of the magnetic department of the Carnegie Institution of Washington, has interested himself in similar work during previous eclipses, and in March, 1918, he issued an appeal for co-operative effort on the occasion of the June eclipse. As a result, observations were taken at a number of stations. Seven of these, in different parts of the United States, were within the belt of totality. There were, besides, eight special field stations in the United States and Canada outside the belt of totality, while observations were taken at twelve ordinary observatories. Dr. Bauer himself observed at Corona, Colorado, a station 11,800 ft. above sea-level.

The general scheme recommended included, in the case of eye readings, observations at one-minute intervals during six consecutive hours, the interval being reduced to thirty seconds at stations within the belt of totality from ten minutes before to ten minutes after totality. In the tables of observational results included single readings are not given, but five-minute means are given for declination at the field stations of the Carnegie Institution. Similar declination data for the field stations of the United States Coast and Geodetic Survey are given in a separate communication by Mr. D. L. Hazard, who also includes readings from the declination, horizontal force, and vertical force curves of the five Coast and Geodetic magnetic observatories. Sir Frederick Stupart deals in another communication with results from Agincourt and Meanook, the two magnetic observatories of the Canadian Meteorological Service, and corresponding results from the magnetic observatory at Antipolo, Manila, are contributed by the magnetic observer of the Weather Bureau.

A number of the declination results before, during, and after the eclipse are shown graphically on p. 110, forming part of the discussion of the phenomena by Messrs. Bauer, Fisk, and Mauchly. The conclusion of their discussion will presumably appear in the next issue of the journal. The day, though comparatively quiet magnetically, was by no means free from irregular movements. Also North American stations are naturally more disturbed than European stations in the same latitude. Thus the task before Messrs. Bauer, Fisk, and Mauchly of disentangling any eclipse effect from other disturbing effects is scarcely likely to be easy. Observations taken during previous eclipses have shown that the eclipse effect, if there is one, is not large. Thus, unless some trait can be recognised as common to a number of eclipses, it will be difficult to reach any positive conclusion. This doubtless explains why the Department of Terrestrial Magnetism, not content with what has been done during 1918, has already arranged to send two expeditions to places favourable for observations during the ensuing solar eclipse on May 29 next. Those organising similar expeditions are requested to communicate with Dr. Bauer.

Amongst the other contents of the volume there is an interesting comparison by Mr. W. E. W. Jackson of the magnetic declination results obtained during 1917 at Agincourt (Toronto) and the new magnetic observatory at Meanook, Alberta (54° 37′ N., 113° 21′ W.). As might be expected from its geographical position, Meanook is a much more disturbed station than Agincourt. Also, as is common with North American stations, it is much more disturbed than European stations in similar latitudes. The mean absolute diurnal variation was 22·6′ even in December, and 78·6′ in August. The regular diurnal variation is analysed by Mr. Jackson in Fourier waves. The wave of twenty-four-hour period is found to have a considerably greater relative importance at Meanook than at Agincourt. The station possesses, in fact, characteristics that recent Antarctic expeditions have shown to exist in high magnetic latitudes. Apparently as yet only declination is recorded at Meanook. It is scarcely necessary to say that the addition of horizontal force and vertical force magnetographs at a station presenting such interesting features is much to be desired.

C. CHREE.

METEOROLOGY AND AVIATION.[1]

THE future development of meteorology will almost certainly be closely associated with that of commercial aviation. On one hand, an accurate knowledge of the conditions of wind and weather over a wide area for at least twelve hours in advance will be essential to aerial navigation; while, on the other, aeroplanes provide a means of obtaining information of great value to meteorologists, particularly with regard to clouds.

Clouds are frequently in the form of horizontal sheets, and these are important from the point of view of aerial navigation when they occur at low altitudes. A fairly good example of the upper surface of such a sheet is shown in Fig. 2, but much flatter sheets are sometimes seen. The clouds are caused mainly by the cooling by expansion of water vapour

[1] The accompanying illustrations are from a paper entitled "The Upper Air: Some Impressions Gained by Flying," contributed to the Journal of the Scottish Meteorological Society (vol. xviii., No. 35). We are indebted to the society for the loan of the blocks. The photographs and observations were obtained while flying in France in co-operation with the Meteorological Section R.E., and the author is indebted to the Commandant for facilities in obtaining them and for permission to reproduce them.

which is diffused up by innumerable eddies. In the case of low sheets the process of mixing of saturated air of different temperatures also plays a part, the mixing being carried out by eddies, which are sometimes of a very feeble character and barely perceptible to aeroplanes. Eddy motion is set up by friction with the surface, and usually transmitted to some extent up to about 3000 ft., and sometimes to about 8000 ft., when the air is being heated at the surface. At greater heights eddy motion may be developed throughout a layer 1000 ft. or 2000 ft. thick when the lapse-rate of temperature (vertical temperature gradient) equals the adiabatic rate owing to the intrusion of a cold layer, and if the humidity is high enough clouds may form at the top of the turbulent layer. Sheets of ripple "alto-cumulus" clouds often develop in this way. In order that the clouds may remain in the form of a horizontal sheet, it is important that the lapse-rate above them should be below the adiabatic for saturated air. The majority of cloud-sheets are found under temperature "inversions," where the conditions are most favourable for their persistence. In anticyclones large inversions are often found above the clouds, apparently due to the presence of a mass of air which slowly descends and is dynamically heated, but which fails to reach the ground. For instance, near Ipswich on November 14, 1918, the temperature was 29° F. at the top of the clouds at 3900 ft., and rose to 43° F. at 4200 ft., the relative humidity falling to 23 per cent. It seems probable that on these occasions the lower air has been drawn from a cold source and then warmed at the surface during its passage over relatively warm seas, as there is always an adiabatic lapse-rate and a good deal of turbulence under the clouds, which carries up the moisture from below. The inversion damps out the turbulence and prevents the clouds from mixing with the dry air above, which would dissolve them entirely. The clouds may persist long after the air has begun

FIG. 1.—A cloud-sheet at 8000 ft.; cumulo-nimbus on the horizon; large anvil, with level top at about 20,000 ft., on the right. Note the false cirrus in front of the sun. 5.20 p.m., September 23, 1918.

FIG. 2.—The clouds of Fig. 1 taken ten minutes later. 5.30 p.m., September 23, 1918.

to be cooled at the surface, and travel horizontally for great distances, the air being turbulent just underneath them. In winter they prevent local inland fogs and frost from developing, as they reflect back the radiation from the surface.

In many cases in winter or over the sea accurate forecasts of the height and thickness of the clouds could be made on the assumption that they travel horizontally without change of form. This is true for some cloud-sheets with their lower surface practically on the ground, when the air above them is in a stable condition. On summer days over the land the clouds tend to assume the form of cumulus, but their height and character can often be foretold from the temperature and humidity at different heights.

Figs. 1 and 2 show cumulo-nimbus clouds over the sea which had grown up through a cloud-sheet between 7000 ft. and 8000 ft. There were cumulus clouds from 2500 ft. upwards, and some of them grew up through the cloud-sheet and finally developed into showers or thunderstorms. Those in the photographs resulted in thunderstorms which reached 20,000 ft., lightning being seen after dark. The conditions were unstable, the temperature being 60° at the surface, 49° at 2000 ft., and 6° at 13,000 ft.; the adiabatic for saturated air is $3\frac{1}{2}$° F. per 1000 ft. The lapse-rate just above the cloud-sheet at 8000 ft. was stable enough to allow it to persist for a few hours, except where it was broken through from below. The cumulo-nimbus on the left of Fig. 1 had a very strange form, and had grown larger when Fig. 2 was taken ten minutes later. The clouds moved from W.N.W., but the form of the false-cirrus on the top of the cumulo-nimbus gives evidence of the existence of a south-westerly current at 20,000 ft., which possibly caused a slight inversion, and was responsible for the flat top of the distant cumulo-nimbus on the right.

FIG. 4.—Rounded top of a cumulo-nimbus cloud from which a shower is falling. Snow-shower falling from thin high cloud in background. 8 a.m., September 19, 1918.

FIG. 3.—Large towering cumuli. 6 p.m., May 17, 1918.

The "false cirrus," of which an example is seen in Figs. 1 and 2, consists of thin snow, which is originally developed from supercooled water-drops within the cumulo-nimbus cloud. Sometimes also minute ice-crystals, which sparkle in the sun and cause halo phenomena, are found floating about the tops and edges of showers, occasionally below 10,000 ft. Clouds consisting of supercooled drops cause corona rings, and sometimes also fog-bows.

Fig. 3 shows large towering cumuli over the land on a hot summer evening, with their bases at 5000 ft. and their tops fully 15,000 ft. They were caused by very powerful upward currents developed in the lower atmosphere, where the lapse-rate reached the adiabatic for dry air. The lapse-rate above 6000 ft. was close enough to the adiabatic for saturated air to allow the clouds to tower upwards. They finally broke up without developing into thunderstorms. Fig. 4 shows the rounded top of a cloud extending from 2500 ft. to 10,000 ft., which caused a shower. A powerful upward current in the lower air caused the top to rise until it was colder than the air surrounding it, as frequently happens, but it soon sank down again. The temperature was 54° F. at 2000 ft., 40° at 6000 ft., and 30° at 10,000 ft. The photograph also shows a snow shower falling for 2000 ft. or 3000 ft. from a thin high cloud, and then evaporating, and cirro-stratus clouds at a great height.

Many cloud-sheets develop in layers of high relative humidity as the result of gradual vertical movements over a wide area, which may affect stable layers thousands of feet in depth. These vertical movements are associated with the complex wind system which often exists in the lower atmosphere, due to a complex thermal structure. They remain gradual so long as conditions are stable, but may have important consequences with certain distributions of upper-air temperature and humidity. Sometimes clouds develop at about 6000 ft. or 8000 ft., when the temperature is unusually high at their level and the lapse-rate above them is unstable, so that they ultimately grow to thunderclouds with their tops above 20,000 ft. This process must not be confused with that illustrated by Figs. 1 and 2, when the clouds grow up through a cloud-sheet from a low level.

In the front half of depressions the humidity is sometimes high from a low level up to above 15,000 ft., with either a series of cloud-sheets near together or a thin, ill-defined mist of great depth. Steady rain readily develops from such clouds, but this is unlikely to be heavy unless the conditions are unstable. Favourable conditions for heavy rain occur when there is a cold body of surface air to displace the warm, damp current, and also an unstable lapse-rate of temperature in the upper air, so that the warm air rises bodily and parts with its moisture. The lapse-rate is not necessarily high near the surface; it is clear that with a given surface temperature the possible water-content of the atmosphere is much greater when the temperature is high to about 6000 ft. than when it falls off rapidly from the surface upwards.

An interesting problem on which aeroplane observations throw some light is that of visibility. The present writer has made observations in different places which show that much of the smoke from towns and factories travels for hundreds of miles. In winter it usually lies near the ground, but in summer the convection currents carry it up to 6000 ft., and sometimes to 10,000 ft. If there is an inversion above the haze, the top is sharply defined. A little smoke-haze is sometimes met with at great heights, but it is nearly always possible to see the clouds to the horizon.

Regular observations of temperature and humidity in the upper air at several stations would be of great value to forecasters. In particular, they should throw light on the minor irregularities which have such an important influence on the weather, and should enable exact short-period forecasts to be made with greater confidence than has hitherto been possible. The accumulation of data as to the upper-air conditions in the various currents which reach our shores should lead to results of far-reaching importance to meteorology.

C. K. M. DOUGLAS.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A course of three lectures on "The Principles of Palæobotany" will be given at University College by Dr. Marie Stopes on Thursdays, February 27 and March 6 and 13, at 5 p.m. The lectures will be specially adapted to students of botany and geology, but are open to members of the general public who may be interested in them.

OXFORD.—Congregation has lately approved the preamble of a statute putting the professorship of forestry held by Sir William Schlich on a permanent basis. Ever since the transfer, some fourteen years ago, of the Coopers Hill School to Oxford, the study of forestry has continued to assume increasing importance among the studies of the University. This has been in chief measure due to the zealous activity of Sir William Schlich himself, and to the wise co-operation of several of the colleges, notably Magdalen and St. John's. The recent establishment of a new school of agriculture and forestry, supplementary to the former diplomas in those subjects, is an experiment which will be watched with interest, especially as it met with some criticism in its early stages. But there is much reason to believe that the study of these subjects will attain a still higher degree of efficiency than at present.

Congregation will shortly have before it a statute for the reform of Responsions. This measure, if carried in its present form, will have the effect of making either Latin or Greek optional in the examination, and either mathematics or natural science obligatory.

ST. ANDREWS.—The University Court has announced that, under the will of the late Mrs. Purdie, widow of Emeritus Prof. Purdie, the residue of her estate, amounting to about 25,000*l.*, has been bequeathed to the University. This bequest is to be applied exclusively to the promotion of research in chemistry at St. Andrews, and, together with the existing endowment of the chemical research laboratories, places at the disposal of the University a total of approximately 33,000*l.* for the prosecution of original work in this subject. The gift, the terms of which permit of the income being used for the purchase of research equipment and for the foundation of research scholarships, is a fitting close to a long list of benefactions which the chemistry school of St. Andrews owes to the Purdie family.

The development of the chemistry department of the United College as a centre for research is largely due to the efforts of the late Prof. Purdie, and when, in 1893, the accommodation of the laboratories became insufficient, a new laboratory for undergraduates was presented to the University by his aunt, Mrs. Purdie, of Castlecliff. Ten years later Prof. Purdie built and equipped at a cost of about 15,000*l.* a separate institute for chemical research, and as both the University and the Carnegie Trust joined in the scheme, it was possible to create a special endowment fund so that workers could carry out their researches without expense. As the numbers increased Prof. Purdie added to the fund, and this prudent measure enabled a steady succession of graduates to remain at the University and acquire training and experience in research. His generous policy has been justified, and, in time, has enabled the St. Andrews laboratory to play an important part in solving many scientific problems arising out of the war.

ON Tuesday, February 18, Dr. C. C. Carpenter, chairman of the South Metropolitan Gas Co., will distribute prizes and certificates at the Sir John Cass Technical Institute, and will deliver an address.

WE are requested to state that the date for the sending in of applications for the Theresa Seessel research fellowships at Yale University has been altered from April 1 to May 1, 1919. Applications, accompanied by reprints of scientific publications and letters of recommendation, together with particulars of the candidate's proposed problem of research, have to be made to the Dean of the Graduate School, Yale University, New Haven, Conn., U.S.A.

REFERRING in NATURE of January 16 to the salaries of university lecturers, Mr. R. Douglas Laurie said: "The Scottish lecturers have been recently granted a graded scale rising to 750*l*." Dr. R. J. T. Bell, University of Glasgow, and Mr. J. K. Wood, University of St. Andrews, write to point out that this scale of salaries has not yet been granted, and that the maximum salaries at present are about half the amount stated. The general councils of the four Scottish Universities have recommended the adoption of the scale, but the University Courts, which are the actual executive bodies, have not yet been able to accept the proposal, though it is understood that the recommendation has met with a sympathetic reception. The difficulty in Scotland, as in other parts of the kingdom, is one of funds, and apparently it can be overcome only by largely increased Treasury grants to the universities.

LT.-COL. C. S. MYERS's recent lectures at the Royal Institution came as a revelation to many scientific men of the important *rôle* which psychology is beginning to play in many departments of practical life. On account of the war the subject has been given special attention, and nobody will dispute the fact of its having made good, both as a source of therapeutic principles in certain types of neurosis and as a means of selecting men for special war service. Long before the war America led the way in showing the applicability of the methods of the psychologist to the problem of selecting the right man for the right job. We now learn that Columbia University is carrying the idea still further. In future, matriculation candidates are to submit themselves to psychological tests with a view to the elimination of those unfit to profit by university studies. Their entrance examinations have apparently not succeeded in excluding candidates who owe their success entirely to special coaching, and for whom a university course is, in fact, a waste of time and effort. We must wait for further information before discussing a scheme which is said to be "based on the Binet formula—whatever that may mean—modified by the tests used in the American War Department." The defects of matriculation examinations as a test of fitness for university work are recognised by all university teachers, and if the Columbia experiment is successful in accomplishing its object the gain will be considerable.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 30.—Sir J. J. Thomson, president, in the chair.—Prof. J. C. **McLennan** and R. J. **Lang**: An investigation of extreme ultra-violet spectra with a vacuum grating spectrograph. In this investigation the vacuum grating spectrograph used was designed and constructed by the Adam Hilger Co. The grating had a ruling 2·5 cm. wide and 1·9 cm. in length, of 20,000 lines to the inch. Its radius of curvature was 120 cm. The vacuum arc spectra of mercury, copper, iron, and carbon were investigated. With carbon, wave-lengths were observed and measured down to $\lambda=584$ Å.U.—Prof. J. C. **McLennan** and J. F. T. **Young**: The absorption spectra and the ionisation potentials of calcium, strontium, and barium. In this paper it is shown that the wave-lengths constituting the series $\delta=(1{\cdot}5, S)-(m, P)$, which are strongly absorbed by the vapours of calcium and strontium, are also strongly absorbed by the vapour of barium. The wave-length of frequency $\delta=(1{\cdot}5, S)$ for barium has been shown to be $\lambda=2380{\cdot}56$ Å.U., and the wave-lengths of the two series $\delta=(2{\cdot}5, S)-(m, P)$ and $\delta=(3{\cdot}5, S)-(m, P)$ have been calculated. The wave-length of frequency $\delta=(1{\cdot}5, S)-(2, p_2)$ has been deduced as $\lambda=7901{\cdot}11$ Å.U. Assuming that the ionisation potential for barium is given by the relation $Ve=h\delta$, where $\delta=(1{\cdot}5, S)$, the value of this magnitude for barium has been calculated to be 5·21 volts.—Prof. J. C. **McLennan**, D. S. **Ainslie**, and D. S. **Fuller**: Vacuum arc spectra of various elements in the extreme ultra-violet. The experiments described were carried out with a fluorite spectrograph the optical train of which consisted of a 60° prism and two biconvex lenses of 15 cm. focal length. The vacuum arc spectra of copper, zinc, aluminium, carbon, thallium, tin, lead, iron, cobalt, nickel, and cadmium were investigated between $\lambda=2400$ Å.U. and $\lambda=1400$ Å.U. The measurements obtained for the vacuum arc spectra of copper, zinc, cadmium, and aluminium are well covered by the results for the spark spectrum of these metals, as obtained by previous workers. For tin, lead, and thallium, the results agree fairly well with those given by Saunders from $\lambda=2400$ Å.U. to $\lambda=1700$ Å.U. Below the region covered by Saunders's work many new lines were observed and measured. The measurements for the vacuum arc spectra of iron, cobalt, nickel, and carbon appear to be the first obtained for the arc spectra of these substances in the Schumann region. For these spectra nearly all the measurements between $\lambda=2400$ Å.U. and $\lambda=1850$ Å.U., as given in the paper, are covered by previous work on their spark spectra. Within the region between $\lambda=1850$ Å.U. and $\lambda=1400$ Å.U. a number of new lines were photographed and measured.—R. C. **Dearle**: Emission and absorption in the infra-red spectra of mercury, zinc, and cadmium. In the investigation described in this communication the absorption spectra of mercury, zinc, and cadmium were studied with a Hilger infra-red spectrograph provided with a rock-salt prism and a linear thermopile, in conjunction with a Paschen galvanometer made by the Cambridge Scientific Instrument Co. With each of the vapours the range investigated lay between $1{\cdot}0\mu$ and $1{\cdot}6\mu$. In studying the emission spectrum of mercury vapour bombarded by electrons, it was found that radiation of the wave-length $\lambda=10{,}140$ Å.U. was emitted with impact voltages so low as 5 volts, and evidence was also obtained indicating that mercury vapour could be made to emit radiation of this wave-length with impact voltages less than 5 volts. The paper presents some considerations in support of the view that while mercury vapour has an ionisation potential of one type of 10·4 volts, it may also have an ionisation potential of a second type of about 2·5 volts.—E. **Wilson**: The measurement of magnetic susceptibilities of low order. (1) An instrument which has been designed for the measurement of magnetic susceptibility of low order. It depends for its action upon the pull exerted by an electromagnet in accordance with the well-known Maxwell expression for the mechanical force exerted upon unit volume of the substance. This mechanical force is balanced against the force of torsion in a phosphor-bronze strip. (2) The instrumental constant is determined from data obtained directly with the instrument itself, and by the employment of substances the susceptibilities of which had been measured by other methods. A modified method of using a ballistic galvanometer has been devised which leads to greater sensitiveness. Rock specimens and other substances have been used, and some interesting results obtained. It is shown that the susceptibility of 13 per cent. manganese alloy is much smaller than is usually supposed. (3) The susceptibility of powdered rock specimens has been measured and compared with the solid. A very fair agreement has been obtained between the two, and the method has the advantage that powders can be rapidly made. (4) The susceptibilities of varieties of mica have been measured, and it is shown that in certain cases, in a direction parallel with the laminæ, the susceptibility may be more than fifty-fold that obtained in a direction at right angles thereto. (5) A series of light aluminium alloys has been tested, and it has been found that, whereas the susceptibility of commercial aluminium is increased by alloying with copper and manganese, it is diminished by alloying with cobalt. (6) It is shown that the balance could be used to determine rapidly the relative amounts of ferrous iron in different specimens of glass. (7) Certain specimens of tourmaline have been examined. The green and dark blue opaque varieties have susceptibilities in the direction of the principal crystallographic axis varying from 16 to 20 per cent. less than in a direction at right angles thereto. The susceptibility of rose-coloured tourmaline is very small in comparison. (8) The paper concludes with a note on the retentivity of rock specimens and its possible influence upon magnetic disturbances in magnetic survey work. —Dr. F. **Horton** and Ann C. **Davies**: An experimental determination of the ionisation potential for electrons in helium. An investigation of the minimum potential difference through which an electron must fall in order to be able to ionise an atom of helium on collision with it has been made by methods capable of distinguishing between ionisation of the gas and secondary effects due to radiation. It has been found that radiation is produced when electrons having a velocity of 20·4 volts collide with helium atoms, and that this is not accompanied by any ionisation of the gas. It has also been found that ionisation of the helium does not occur until the velocity of the electrons is raised to 25·6 volts, and that no other type of radiation is produced at this point.

Linnean Society, January 16.—Sir David Prain, president, in the chair.—Capt. A. W. **Hill**: Horticultural work carried out in the military cemeteries in France since 1916. Reference was also made in the paper to the cemeteries in the Italian and other theatres of war. It is intended to make the cemeteries, so far as possible, smooth, well-kept grass-lawns, surrounded by hedges of thorn, beech, or hornbeam, with groups, avenues, or pole-hedges of trees, such as Siberian crabs, limes, hornbeams, willows, etc., and to plant on the graves rose-bushes, iris, and other dwarf carpeting-plants. Steps are also being taken, where possible, to mark the cemeteries where Canadian, Australian, New Zealand, Indian, and other Overseas soldiers lie buried with plants native to the countries whence they came to the defence of the Empire. Allusion was made to the problems which have to be faced in the matter of soil and site, which often render successful gardening work very difficult. Some of the cemeteries are in very sandy places, others in chalk, whilst a number are in the fenland of the Belgian border.

Geological Society, January 22.—Mr. G. W. Lamplugh, president, in the chair.—C. J. **Gilbert**: The occurrence of extensive deposits of high-level sands and gravels resting upon the chalk at Little Heath, near Berkhamsted. In a pit at Little Heath Common, on a plateau of the Chiltern Hills, the following section has been developed:—Surface soil with bleached flint pebbles from the Reading beds, about 2 ft. in thickness; pebbly clay and other Glacial deposits, varying from 2 ft. to 20 ft.; stratified loamy sand, 5 ft. to 6 ft.; stratified coarse gravel, 17 ft.; dark clay, with black-coated, unworn flints and small, well-rounded pebbles, 6 in.; and chalk. The upper Glacial deposit is a pebbly clay. The pebbles are derived from the Reading beds. The clay matrix is tough, and the tints of the clay leave no doubt that it has been derived from the upper part of the Reading beds. The chalk flints are absent, while the small pebbles of white quartz and lydite are seldom met with. On the west side of the pit, underlying the pebbly clay, is a disturbed mass of Glacial sands and clay of miscellaneous character. The whole deposit is suggestive of an englacial origin. Beneath the Glacial beds is a stratified deposit of dark reddish-brown, mottled, loamy sand. The entire deposit is banded with fine lines of grey clay. There is almost invariably a break between the loamy sands and the gravels. The laminæ of the loamy sands do not always follow the contour-line of the beach, but are deposited horizontally. The underlying gravel deposit consists of Reading pebbles and water-worn flints in equal quantities, with an occasional pebble of puddingstone from the Reading beds. No rocks foreign to the district have been found. The gravel becomes coarser in depth, the lower sections containing a high percentage of large, water-worn flints. The small stones are mostly Reading pebbles and white quartz. The gravel is homogeneous. Recent researches indicate that the quartz and lydite pebbles in this district have been derived from the Lower Greensand after the final breach of the Chiltern scarp, in the gaps of which the quartz pebbles are found in such abundance. Reasons are adduced in support of the contention that the loamy sands and gravels are marine deposits laid down in a shallow sea, and that they cannot be of Glacial origin.—G. **Barrow**: Notes on the correlation of the deposits described in Mr. C. J. Gilbert's paper with the high-level gravels of the South of England (or the London Basin). The gravels belong to deposits of which the harder constituents have been derived from two areas, one within the chalk escarpment, the other beyond this escarpment, but within that of the Lower Greensand. The constituents of the former are Reading or other Tertiary pebbles, and flint. Pebbles of sarsen are not uncommon. The pebbles in the latter area consist of white quartz and lydite, all small. "Far-travelled" stones, derived from the Bunter, Carboniferous Limestone, Red Chalk, etc., are absent. Outliers of the finer deposits have been met with. The coarser gravels occur on the south side of the Thames up to above 600 ft.; these all rest on the chalk. It has been pointed out that there must be corresponding coarser gravels also resting upon the chalk on the north side of the Thames, and the occurrence described by Mr. Gilbert now shows that this is the case.

CAMBRIDGE.

Philosophical Society, February 3.—E. H. **Neville**: The Gauss-Bonnet theorem for multiply connected regions of a surface.—L. J. **Mordell**: The representations of a number as a sum of an odd number of squares.—N. M. **Shah** and B. M. **Wilson**: Certain empirical formulæ connected with Goldbach's theorem.—G. H. **Hardy** and J. E. **Littlewood**: Notes on Messrs. Shah and Wilson's paper entitled "Certain Empirical Formulæ Connected with Goldbach's Theorem."

MANCHESTER.

Literary and Philosophical Society, January 21.—Mr. W. Thomson, president, in the chair.—Discussion on the means by which the society may promote most effectively the advancement and application of learning in Manchester. Among the suggestions put forward were the following:—(1) That while the society should retain its present functions as a learned society, its members might meet with others interested in the advancement of science for informal discussion in the rooms of the society; (2) that special lectures by eminent men on scientific subjects of general interest should be arranged from time to time; (3) that addresses on the practical applications of science by scientific men engaged in industry should be invited; (4) that the presidents of the various scientific societies in Manchester might be made associate or honorary members during their period of office, and that such societies should be invited from time to time to hold special meetings of general interest in the society's house; and (5) that facilities might be arranged for members to consult the library in the evenings, and that arrangements might be made whereby members of other societies should be able on certain terms to use the library.

PARIS.

Academy of Sciences, January 27.—M. Léon Guignard in the chair.—L. **Mangin**: The harmful action of the emanations from the Chedde factory. The fumes from this explosives works are finally converted by the action of moisture into hydrochloric acid. The zone affected is an ellipse ten kilometres by four kilometres. Trees in this area are unequally affected; Epicea is severely damaged and ultimately killed. *Pinus sylvestris* is attacked, but less severely; firs are only slightly injured. Yews and larches show no alteration.—C. **Guichard**: The deformation of quadrics.—E. **Ariès**: Formula giving the latent heat of evaporation of a liquid.—H. **Parenty**: Regulator and meter for the yield of a spring collected by a horizontal or slightly inclined gallery.—M. Wilfred Kilian was elected a non-resident member in succession to the late M. Pierre Duhem.

J. **Drach**: The algebraical solutions of differential equations of the first order.—P. **Montel**: Polynomials of approximation and the existence of differentials.—E. **Maillet**: Determination of the integral points of algebraical unicursal curves with integral coefficients.—C. **Rabut**: Scientific rules and principles for driving long tunnels under a sheet of water. The author's suggestions are summarised under ten headings, everything being subordinated to the prevention of inundation. The apparent economy of the usual method has been proved in practice to be illusory.

J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the third quarter of 1918. Observations were possible on eighty-six days, and tables are given showing the surfaces of the sun-spots, their distribution in latitude, and the distribution of the faculæ in latitude.—G. A. **Le Roy**: Fires produced by Hertzian waves. The investigation of several cases of fire, after careful examination of the facts, has led to the conclusion that probably Hertzian waves were responsible. An instrument is figured and described by which this incendiary action of the Hertzian waves upon various materials has been investigated experimentally. In practice a compressed bale of cotton held by a steel band might be fired by wireless messages in two ways: a band might be broken, leaving the broken ends close together but not in contact, or such bales might be piled in such a manner that short sparks could pass between the rings and set fire to the cotton.—V. **Cremieu**: Experimental researches on gravitation.—M. **Swyngedauw**: The energy losses in the dielectrics of armoured cables.

F. **Bourion** and Ch. **Courtois**: The conditions of utilisation of Schilling's apparatus for the control of industrial hydrogen. For use in ballooning, a direct measure of the density of the gas is the most useful experimental figure, and this is rapidly measured by Schilling's apparatus. The necessity for correcting the indications for moisture is emphasised, and a formula introducing this correction given.—J. **Jolibois** and A. **Sanfourche**: The constitution of nitrous fumes. If air and nitric oxide are mixed in the ratio required to form N_2O_3, the combination is instantaneous; if in the ratio to form N_2O_4, the N_2O_3 stage is rapidly attained, and a further 100 seconds is required to form 92 per cent. of N_2O_4.—J. **Repelin**: A point of history of the Pacific Ocean. The islands of French Polynesia are generally regarded as of entirely volcanic or coral origin. The island of Makatea contains Tertiary deposits, and details of the fossils found are given.—E. **Mathias**: Rain in France. Calculation of the anomalies and of the altitude coefficient. It is shown that in France the altitude coefficient is constant at all points on a geographical parallel.—J. **Pantel**: Calcium, a form of reserve in the female of the Phasmides: its forms of elimination in the two sexes.—C. **Delezenne** and H. **Morel**: The catalytic action of snake-poison on the nucleic acids. Nucleic acid from yeast and thymonucleic acid were treated in neutral solutions with various snake-poisons. Phosphoric acid is produced, 50°–52° C. being the best temperature for the reaction. The snake-poisons vary in their action, the greater toxicity corresponding with greater hydrolytic action towards the nucleic acids.—A. **Vernes**: The graphics of the syphilitic subject. It is impossible to make a certain diagnosis of syphilis from a single examination of serum, since it is only from the form of the curve obtained from a series of successive examinations that a decisive conclusion can be drawn.—R. **Douris**: The use of heated sera in the Vernes sero-reaction (sero-diagnosis of syphilis).—A. **Berthelot**: Biochemical researches on war-wounds. Searching for the presence of micro-organisms in wounds analogous with *B. aminophilus*, and capable of forming the ptomaine β-imidoazoethylamine from histidine, such bacilli were discovered in cases of gas gangrene and large crushed wounds.—Em. **Bourquelot** and M. **Bridel**: Simultaneous biochemical syntheses of gentobiose and two β-glucosides of glycol by emulsin.—F. **Diénert** and A. **Guillerd**: Aqueous autolysed yeast for the culture of *B. coli*. The continuous rise in the price of peptone has led to a search for more economical media, and a method is described starting with pressed yeast. It has been found that peptone broth costing 3 francs per litre can be perfectly replaced by autolysed yeast broth costing 20 centimes per litre.—A. **Paillot**: Pseudo-fatness, a new disease of the larva of *Lymantria dispar*. The disease is caused by a new cocco-bacillus, which has been isolated and named *Bacillus lymantricola adiposus*.

BOOKS RECEIVED.

Indian Industrial Commission Report, 1916–18. Pp. xx+355+xviii. (Calcutta: Superintendent Government Printing, India, 1918.) 1s. 6d.

Man's Supreme Inheritance: Conscious Guidance and Control in Relation to Human Evolution in Civilisation. By F. M. Alexander. With an Introductory Word by Prof. J. Dewey. Second edition, revised. Pp. xxviii+239. (London: Methuen and Co., Ltd., 1918.) 7s. 6d. net.

A First Course in the Calculus. Part i., Powers of X. By Dr. W. P. Milne and G. J. B. Westcott. Pp. xx+196. (London: G. Bell and Sons, Ltd., 1918.) 3s. 6d.

Fossil Vertebrates in the American Museum of Natural History. Department of Vertebrate Palæontology. Vol. vi., Articles Collected from the American Museum Bulletin of the Years 1915–17. By H. F. Osborn and others. Collected and issued for purposes of sale and exchange. (New York: The American Museum of Natural History, 1918.)

Introductory Lecture to the Classes in Metallurgy in the Royal Technical College, Glasgow, at the Opening of the Session, 1918–19. By Prof. C. H. Desch. (Glasgow: James Maclehose and Sons, 1919.)

Annuaire pour l'an 1919, publié par le Bureau des Longitudes. Pp. viii+524+A60+B27+C69. (Paris: Gauthier-Villars et Cie, n.d.) 3 francs net.

Trattato di Chimica Generale ed Applicata all' Industria. Vol. i. Chimica Inorganica, parte seconda, quarta edizione riveduta ed empliata. By Prof. D. E. Molinari. Pp. x+561–1190. (Milano: Ulrico Hoepli, 1919.) 26 lire.

Imperial University of Tokyo. Calendar 2577–78 (1917–18). Published biennially. Pp. iv+402+tables and plates. (Tokyo: The University.)

The British Journal Photographic Almanac and Photographer's Daily Companion, 1919. Edited by G. E. Brown. Pp. 644. (London: H. Greenwood and Co., Ltd., 1919.) 1s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—Dr. W. Wilson: The Movements of the Sun, Earth, and Moon.

ROYAL SOCIETY, at 4.30.—Hon. R. J. Strutt: Scattering of Light by Solid Substances.—L. Bairstow and A. Berry: Two-Dimensional Solutions of Poisson's and Laplace's Equations.—Dr. G. H. Thomson: The Cause of Hierarchical Order among the Correlation Coefficients of a Number of Variates taken in Pairs.—Dr. G. N. Watson: The Transmission of Electric Waves round the Earth.

MATHEMATICAL SOCIETY, at 5.—Prof. H. S. Carslaw: Diffraction of Waves by a Wedge of any Angle.—T. C. Lewis: Properties of Pentaspherical Co-ordinates.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Bt.-Lt.-Col. W. A. J. O'Meara: The Functions of the Engineer: his Education and Training.

CHILD-STUDY SOCIETY, at 6.—Dr. C. W. Kimmins: The Significance of Children's Dreams.

OPTICAL SOCIETY, at 7.—Annual General Meeting.—At 7.30.—Lord Rayleigh: A Possible Disturbance of a Range-finder by Atmospheric Refraction due to the Motion of the Ship which carries it.—L. C. Martin and Mrs. Griffiths: Deposit on Glass Surfaces in Instruments.

FRIDAY, FEBRUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

ROYAL INSTITUTION, at 5.30.—Prof. C. G. Knott: Earthquake Waves and the Interior of the Earth.

MALACOLOGICAL SOCIETY, at 7.—Annual General Meeting.

MONDAY, FEBRUARY 17.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. J. A. Fleming: Scientific Problems of Electric Wave Telegraphy.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Commander H. D. Warburg: The Admiralty Tide Tables and North Sea Tidal Predictions.

TUESDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 3.—Capt. G. P. Thomson: The Development of Aeroplanes in the Great War.

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—Prof. H. H. Turner: Report on Seismology.—G. W. Walker: Account of Certain Seismological Instruments described by the Late Prince Galitzin.

ROYAL STATISTICAL SOCIETY, at 5.15.—Capt. M. Greenwood: Problems of Industrial Organisation.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—Montagu Summers: The Financing of Oilfields.

ZOOLOGICAL SOCIETY, at 5.30.—R. I. Pocock: The External Characters of the Existing Chevrotains.—K. M. Smith: A Comparative Study of Certain Sense-organs in the Antennæ and Palpi of Diptera.

WEDNESDAY, FEBRUARY 19.

ROYAL SOCIETY OF ARTS, at 4.30.—Dr. J. F. Crowley: The Use of Electricity in Agriculture in Germany.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. S. Chapman: The Lunar Tide in the Earth's Atmosphere.—Miller Christy: The Gunfire on the Continent during 1918: Its Audibility at Chignal St. James, near Chelmsford.

ROYAL AERONAUTICAL SOCIETY, at 8.—C. Grahame White: Civil Aerial Transport—Is it Practicable, is it Safe, and is it Profitable?

ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard: Presidential Address—The Limitations of Microscopy.

THURSDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Prof. H. M. Lefroy: Insect Enemies of our Food Supplies.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Jean Dufrenoy: Note on the Metabolism of the Glucosides of the Arbutin Group.—S. S. Zilva and E. M. Wells: Dental Changes in the Teeth of the Guinea-pig produced by a Scorbutic Diet.—W. E. Bullock and W. Cramer: A New Factor in the Mechanism of Bacterial Infection.—Major W. J. Tulloch: The Distribution of the Serological Types of *B. tetani* in Wounds of Men who received Prophylactic Inoculation, and a Study of the Mechanism of Infection in, and Immunity from, Tetanus.

INSTITUTION OF MINING AND METALLURGY, at 5.—S. J. Truscott: Slime Treatment on Cornish Frames: Supplements.—Edwin Edser: The Comparison of Concentration Results, with Special Reference to the Cornish Method of Concentrating Cassiterite.—C. W. Gudgeon: The Giblin Tin Lode of Tasmania.—G. F. J. Preumont: Notes on the Mining of Wolfram in Bolivia.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

CHEMICAL SOCIETY, at 8.

FRIDAY, FEBRUARY 21.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

ROYAL INSTITUTION, at 5.30.—A. T. Hare: Clock Escapements.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.

SATURDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 3.—Hon. J. W. Fortescue: The Empire's Share in England's Wars—Western Europe.

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

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THURSDAY, FEBRUARY 20, 1919.

EDUCATION IN THE ARMY.

THE publication of the Second Interim Report of the Adult Education Committee of the Ministry of Reconstruction, presided over by the Master of Balliol, on "Education in the Army" (Cd. 9225, price 2*d.*), may raise hopes which a study of the report will disappoint. For the report was written several months before the Armistice, being dated July 3, 1918, and is concerned mainly with the educational problems of an Army living and working under different conditions from those which exist to-day. Some delay has occurred in the publication of the report. An appendix contains a note by Col. Lord Gorell, Deputy Director of Staff Duties (Education) at the War Office, dated November 8, 1918. The creation of this branch at the War Office was one of the chief recommendations of the Committee, which wisely suggested that the proposed new branch should be placed under the direction of a specially qualified military officer of academic distinction and with educational experience. The force of the recommendation may be understood by considering the fact that, although the War Office has charge of important educational institutions like Woolwich and Sandhurst, the examinations for admission to which directly affect the curricula of our secondary schools, it has never called to its aid the services of an officer—civil or military—with such special qualifications, although an excellent precedent was provided by the Admiralty in the appointment in 1903 of Sir Alfred Ewing as Director of Naval Education.

The education of Army officers was presumably not regarded by the Committee as coming within its terms of reference, "adult" being interpreted to mean the man in the ranks rather than the officer. But the Committee has formed a conception of the Army, Navy, and Air Force of the future as great training colleges for the nation; and for this advance the country should be grateful. Due recognition has been given in the report to the efficient educational work of the Y.M.C.A. for the British Army, and the corresponding work in the Canadian and New Zealand Armies. In view of the changed military conditions and the fact that the principal reforms advocated in the report have already been carried out by the War Office, there is not much material in the report for comment or criticism; but we may express the earnest hope that the educational work for the enlisted man, which has been started with so much energy and enthusiasm, will be wisely organised and developed.

The question of the selection, education, and training of the officers of the *post-bellum* Army, scarcely less urgent and important, has apparently not yet received official consideration. Mr. Winston Churchill's appointment as Secretary for War, following close on the happy conclusion of hostilities, suggests that the time has arrived for a frank discussion of the whole subject. The "modern eye" which he claims to possess should find useful work in exploring some of the dark places of the office over which he is now called upon to preside.

We approach the question with a deep sense of obligation to the thousands of brave men who have lost their lives through the educational and scientific deficiencies of our military machine. The Expeditionary Force of the old Regular Army was a well-organised and efficient engine of war, which achieved a magnificent record in the early months of the war by its heroism and devotion to duty, its high standard of discipline, and its excellent Staff work. Consummate skill was shown in its transportation overseas and its supply services. Nevertheless, the conclusion to be drawn from the later history of the war is irresistible. The education and training of the average Army officer were shown to be defective, through his inability to adapt himself to new conditions and to solve the difficult problems which the development of the war presented in bewildering number and variety. An officer who has spent more than three years on active service at the front has given it as his considered opinion that, of the daily problems confronting the regimental officer, more than 99 per cent. required brains rather than courage for their solution, and were solved or left unsolved according as the officer had received preliminary training and possessed the necessary natural ability.

War's arbitrament has finally destroyed the cherished idea that "brains" and "bravery" are mutually exclusive. The distinctions obtained by university-trained officers in the war are conclusive evidence on this point. In the case of one university O.T.C., four out of five V.C.'s were obtained by officers who had taken the university degree or its equivalent. The scholar-soldier is not a contradiction in terms. Mental training develops personality. "I don't like work—no man does," says Joseph Conrad, "but I like what is in work—the chance to find oneself." We must bear these facts in mind in considering the pre-war policy as regards the selection and training of officers for the Army. Whether Parliament or the War Office was mainly responsible we are not in a position to determine, but it is undoubtedly a fact that commissioned service in the Army was restricted to men of means and leisure, and educational standards had to be adjusted accordingly. Sir Henry Campbell-Bannerman acknowledged in the House of Commons on March 9, 1903, that the crucial question of Army organisation was whether this system should continue. In his evidence before the Military Education Committee which was set up after the South African War, Sir Evelyn Wood said: "I am sorry to say that the officer wanted in the Army is only one who can command 150*l.* to 1500*l.* a year; there is no room at all in the Army—and that comes before me every day—for the man who has only 50*l.* a year of his own."

Such was the position when Lord Haldane became Secretary for War in 1905. Unfortunately for the nation, Lord Haldane preferred precept to practice. His *apologia* during these crucial years on high educational standards and democratic principles was intended for outside consumption. He was either unwilling or unable to overcome the *vis inertiae* of Army tradition. During his years of office educational standards for officers of the Regular Army were actually reduced, for no other result could follow the lowering of the age-limit for the Sandhurst examination from seventeen and a half to sixteen and a half—a change which had the further vicious result of interfering with the proper work of our secondary schools. The position as regards the supply of officers for the Army became so desperate that the competitive examination for Sandhurst was reduced almost to a farce as the number of candidates approximated to the number of places. Can it be doubted that a good many educational "duds" gained admission to our largest military college? Further, the immature youths who joined the college were provided with an educational course which, judged by modern standards, was too short and altogether inadequate in scope and character. Training in scientific method was entirely lacking. At one period, we believe, the whole course only lasted for about nine months. Much of the time available was necessarily taken up with drill, horsemanship, and routine military training. Those who know the facts can read Mr. Thomas Seccombe's brilliant preface to "The Loom of Youth" without surprise. The products of this system of education were pitted in the war against highly trained officers of a nation which, whatever its failings may be, has a profound respect for science and education.

As we have already indicated, the Army has now taken up with great energy the further education of "Old Bill," that lovable figure who, by his cheerful courage and self-sacrifice, has shown himself able to satisfy some of the highest tests of education. We shall refuse to show any great enthusiasm for this work until there is a complete change of heart at the War Office as regards the higher direction of the Army. The old "caste" theories have been shattered by the war. "Old Bill" asks primarily to be led by an officer who knows his job, whatever his private income or ancestry may be. The Army must be brought into the main stream of the nation's educational and scientific life. Mr. Churchill's first lesson will be to learn that an A1 Army cannot be made with C3 brains. His task at the War Office must be to set up an Army, not inferior to the old Army in discipline and devotion to duty, but immensely superior in its respect for science and education. It should be a model organisation which other great national institutions will aspire to copy in its educational standards and the application of science to all departments of its work, in its conditions of employment, its belief in equality of opportunity, its standards of health and discipline—an Army for which compulsion will be unnecessary, because every public-spirited citizen will desire to take advantage of the opportunities it offers for educational and physical training.

We may add with confidence that, in accord with the democratic conditions under which our national life will in future be lived, some system will have to be devised for selecting men from the ranks who have attained the necessary educational standard and for training them for commissioned service. For this important task and for the training of ordinary university students as Regular and Reserve officers the establishment of residential military colleges within existing universities is clearly indicated. The success of the universities in training officers for the Army through their contingents of the Officers Training Corps, and through the exiguous scheme for university commissions in the Regular Army which was in operation before the war, warrants confidence in their ability to discharge the wider functions suggested. Any such scheme would have the further effect of bringing the Army into closer touch with the educational and scientific thought of the universities and with the results of research in all departments of knowledge. If the ancient and honourable profession of arms is to be made a real profession in a modern sense, a high standard of selection and training must be demanded. Under no other conditions can the reasonable demands of Army officers for higher pay and improved prospects be granted by a grateful country.

ANCIENT PALESTINIAN FOLK-LORE.

Folk-Lore in the Old Testament: Studies in Comparative Religion, Legend, and Law. In 3 vols. By Sir James G. Frazer. Vol. i., pp. xxv+569; vol. ii., pp. xxi+571; vol. iii., pp. xviii+566. (London: Macmillan and Co., Ltd., 1918.) Price, 3 vols., 37*s.* 6*d.* net.

In certain parts of Palestine there used to dwell a savage people who were called 'Ibhrim, or Hebrews, whose customs show that they were originally slaves to the same crude and cruel semi-religious observances as may be found in any modern uncivilised tribe. If an explorer, well equipped with all that science can endow for collecting, collating, and recording primitive folk-lore, had gone among them and studied them, his labours would show that these same Hebrews, who were to have such an effect on the Western world for at least two thousand years, were scarcely different in their habits and customs from any other barbarians. As, however, this people has passed away from Palestine, the explorer cannot get into direct touch with them, and he must either dig up their records from their ancient cities, or so analyse their writings that he can trace the origins of obscure customs by comparison with those of other races.

This latter method Sir James Frazer has applied to the Old Testament, with all his usual energy and in his apt, mellifluous style. His three volumes show with a wealth of detail how little was the difference between the original Semite and the savage of to-day. It is perhaps one of the saddest phases of human adventure that this savagery, made respectable by being wedded to subsequent civilisation and veneered with an ecclesiastical gloss, should have been considered the justification for so much fanatic cruelty in the late medieval and early Victorian periods. The Palestine Exploration Fund excavations at Gezer under Macalister showed that it was the Hebrews who were the real Philistines, in the artistic sense of the word, and their crude productions which were discovered undoubtedly deserved this paradoxical epithet.

These three volumes should be the household companion of every religious teacher, nay, of everyone who cares or dares to see what that latest daughter of science, folk-lore, has to say about the cherished beliefs from the Old Testament, absorbed in infancy and rarely visualised differently in later life. There are plenty of Englishmen still who believe the conservatism of childhood's religious conceptions to be a virtue, and the danger to humanity of such immature conceptions, atrophied naturally by a complacent neglect, is obvious. Not many laymen, for instance, even now know that there are two widely different accounts in Genesis of the Creation, the Sacred Tree, and the Flood, welded into composite stories, and yet these stories are still believed to be a divine revelation.

How much exercised the theologians have been over the apparent iniquity of Jacob, and how pathetic the explanation that, although the deed was wrong, it demonstrated Jacob's cleverer nature, thus fitting him for his stupendous future! Who does not remember his juvenile disgust at the way in which Jacob usurped his brother's right by chicanery? And who would have thought that in reality he was merely laying claim to his own on the grounds of ultimogeniture? Many savage tribes recognise the rights of the last-born in inheritance, and this custom, according to Sir James Frazer, is compatible with both the agricultural and the pastoral way of life: "As the sons of a family grow up, they successively quit the parental abode and clear for themselves fresh fields in the forest or jungle, till only the youngest is left at home with his parents; he is therefore the natural support and guardian of his parents in their old age. This seems to be the simplest and most probable explanation of ultimogeniture." It would therefore appear on these grounds plausible that that unamiable Oriental Jacob, as the younger son, had a certain righteous claim to what he is said to have obtained by fraud, a defence "undertaken by a compatriot and namesake, Mr. Joseph Jacobs, who has essayed to wipe out the blot on the ancestral scutcheon." The other part of the story, how he dressed himself in skins, follows naturally from Sir James Frazer's ingenious explanation that it was a survival of the custom of re-birth. Primitive peoples, when adopting children, frequently go through a pantomime representing a new birth, and this in certain cases includes the ceremony of investing the new son with the skins of sacrificed animals.

The Brand of Cain is another problem for which a new theory is provided. Robertson Smith thought that it was a tribal mark, a badge which every member of the tribe wore on his person, which served to protect him by indicating that he belonged to a tribe which would avenge his murder. The later explanation, far more plausible, is that it was a mark laid on Cain to prevent the ghost of his murdered brother recognising him and haunting him. This is obvious from the numerous similarities collected by Sir James Frazer from savages; for instance, among the Yabim of New Guinea, when the kinsmen of a murdered man have accepted a blood-wit instead of avenging his death, they take care to be marked with chalk on the forehead by the relatives of the murderer, "lest the ghost should trouble them for failing to avenge his death." It is, in fact, closely allied to an external sign of mourning for the dead which so changes the appearance of the mourner that the ghost cannot return to annoy him.

Again, the difficult problem of the slave who, although having the right of freedom after his sixth year of service, elected to remain to serve his master continuously is discussed at length. Everyone will call to mind the curious treatment with which his new undertaking was inaugurated: his ear was to be bored through with an awl at the doorpost by his master. The parallels from savage folk-lore are sufficiently similar to show that some form of magic underlies the ceremony. Among the Ewe negroes of Togoland, when any of the tribe desire to prevent a slave from running away, it is customary to bring him before a fetish named Nanyo, where the priest pares the nails of the slave's fingers and toes, shears some of the hair of his head, and buries all the parings and cuttings in the earth with a fetish mark. Other ceremonies are included, but those quoted are ample to show (from the common beliefs about magical powers obtained through possession of the nail-parings and hair of an enemy) that the master has now some occult control over his servant. In the case of the Hebrew slave it is the blood which represents the substance through which the control is acquired; and when the earlier form of the Hebrew law, as recorded in Exodus, is remembered ("then his master shall bring him unto God, and shall bring him to the door, or unto the door-post"), the connection with the savage story is still more striking.

The curious story of Elijah and the ravens is briefly discussed literally. It is curious to see that Sir James Frazer (who read the whole of the Old Testament in Hebrew before undertaking this great work) is apparently unaware of the ingenious but simple emendation of the word "ravens" (*'orĕbhîm*) to "Arabs" by a very slight vowel change, which, of course, renders any mythical explanation unnecessary.

There are one or two small slips noticeable. In the description of Babylon the learned author describes the mound Babil, which is the most northern of the three mounds composing the city, as the site of the ancient temple *E-temen-an-ki* (the real Tower of Babel), which actually lies a little to the north of the southern mound Amran, at least a mile from Babil. Another small slip is "Mandace" (three times, vol. ii., p. 441) for "Mandane," the mother of Cyrus. But the wonder is that, in all this varied display of erudition, the slips should be so small and trivial. It is impossible to do justice to the large number of new theories amply supported by evidence. Hebraists and anthropologists (and, incidentally, examiners for the Oriental Tripos) have at hand a wonderful storehouse, an Aladdin's cave of jewels, on which to ponder. R. C. T.

THE PAST AND FUTURE OF ORGANIC CHEMISTRY.

Recent Advances in Organic Chemistry. By Dr. A. W. Stewart. With an introduction by Prof. J. N. Collie. Third edition. Pp. xx+350. (London: Longmans, Green, and Co., 1918.) Price 14*s*. net.

THE growing mass of research in pure and applied chemistry has created a demand for some kind of periodical summary which will afford the non-specialist an opportunity of following the varied phases of development of the science without wading through the original literature. This demand is being met by the annual reports of the Chemical Society and the Society of Chemical Industry, and to a more limited extent by *Science Progress,* by the "Smithsonian Reports," and by the Journal of the Royal Society of Arts. The volume under review stands in a somewhat different category, for it takes in its successive chapters the character of a general *résumé*, a students' text-book, a critical essay, and a speculative forecast. Such varied treatment has many advantages for both author and reader. For the latter, severe mental application is not demanded, and the matter is sufficiently varied to be stimulating without being wearisome; for the former, free play is permitted to his and other people's imagination without the controlling fetters of unbiassed fact.

The latest edition of Dr. Stewart's well-known book has attempted to sustain its character as a record of new achievements in organic chemistry by deleting some former chapters and replacing them by others of fresher interest. Thus the polymethylene group, the quinols, asymmetric synthesis, and the bibliography have been replaced by accounts of recent researches on chlorophyll, the anthocyanins, the chemistry of rubber, and new arsenic compounds, whilst the chapters on triphenylmethyl and the alkaloids have been somewhat extended.

A book which professes to record recent advances is bound to modify its contents with each succeeding edition as the subjects pass into the range of ascertained facts, and so fall into their natural positions in the scheme of classification. It is a little difficult, therefore, to perceive upon what principle the present selection is made—why certain chapters should be discarded, whilst others which appeared in the earliest edition should be retained almost intact. The opening chapter, on "Organic Chemistry in the Twentieth Century," is extremely lucid and well expressed, but much too superficial to be instructive. Here is a paragraph:—"As far as the benzene nucleus is concerned, the question which has excited most interest recently is the substitution problem; but it cannot be said that, even yet, in spite of extensive investigation, we possess the true key to the riddle," and there the matter ends, and those who do not know what the substitution problem is are referred to a solid treatise of 500 pages by Holleman. Nevertheless, to those familiar with the changes that have taken place during the century, the chapter as a whole will serve as a pleasant reminder.

It may be observed that the theory of isorrepesis is still retained, in spite of the contrary evidence adduced by Lowry, to which no mention is made. The word "ketene," which is derived from ketone, with the usual suffix "ene," denoting doubly linked carbon, is written, *à la* German, "keten," an undesirable modification from every point of view.

The succeeding chapters on the terpenes, the alkaloids, and the polypeptides have undergone little or no change, and are ordinary text-book descriptions; but those on chlorophyll and the anthocyanins are new, and introduce us to some of the most highly complex structures found in organic Nature, the constitution of which has been elucidated in a masterly fashion by Willstätter and his associates.

One of the most interesting chapters in the book is that dealing with theories relating to the synthesis of vital products, the greater part of which, according to the author, has been elaborated by Prof. Collie. Here we enter the realm of speculation; indeed, so little is known of the laboratory methods of the living cell that free rein may be given to the chemical imagination. Enzyme action, of which, however, little of value is said, will probably furnish the key to organic synthesis and cleavage within the living organism, and, until that action has been more fully explained, there is no harm in manufacturing equations and mechanical devices to represent these changes.

One point, however, must be borne in mind—namely, that these changes must take place with comparatively small energy changes, so that the equilibrium may be easily induced to shift, and the balance of a reversible reaction thrown, to one or other side of the normal point; in short, vital reactions, if the expression may be used, must occur within a small range of temperature. In this respect such reactions as the synthesis of pyridine derivatives from malic and citric acids, which were studied many years ago by v. Pechmann and others, and the more recent work on the synthesis of tropinone by Robinson, have an unequivocal significance. J. B. C.

OUR BOOKSHELF.

The Science and Practice of Manuring. For the Use of Amateur, Market, and Professional Growers, Orchardists, etc. By W. Dyke. With introduction by J. Wright. Revised and enlarged edition. Pp. 157. (London: The Lockwood Press (Harvey H. Mason), n.d.) Price 2*s*. net.

MR. DYKE is well known to horticulturists as a man with a strong scientific bent, and by those men of science who are interested in large-scale crop production he is recognised as possessing a considerable stock of problems still requiring solution. The scientific worker will, therefore, take up this book in the hope of finding a record of some of these observations. He will not be altogether disappointed, yet he will not find so much as he might hope; for Mr. Dyke, having written for the practical man and not for the plant physiologist, sets out some of the elementary scientific facts which he considers the grower needs, but he has not always recorded the growers' observations, which the scientific reader would like to have had, and which no doubt Mr. Dyke considered the practical grower did not need to be told.

Mr. Dyke knows his *clientèle* so well that he may safely be trusted to furnish a syllabus of the things they wish to know. To the horticultural lecturer this will be one of the most interesting features of the book.

The information given to the growers is largely sound and likely to be helpful. Some of the data might well be modernised, and a certain number of the figures need correction. In particular some of the statistics in the first chapter are inaccurate; some of the experimental data given in later chapters are old, and more modern figures are available. It is incorrect also to say, on p. 20, that agricultural chemists have "entirely overlooked" the possibility of the presence of ammonium nitrate in the soil. Large numbers of determinations have been made, but in no case is more than a trace of ammonia present either in cropped or uncropped soils. The amount of nitrate, however, may rise considerably. It is very doubtful whether the recommendation of ground leather is sound, and it is certain that a well-made superphosphate does not become wet and sticky, or lose soluble phosphate on keeping, at any rate so long as it is kept in a weather-proof shed.

The Life and Discoveries of Michael Faraday. By Dr. J. A. Crowther. ("Pioneers of Progress," Men of Science Series.) Pp. 72+portrait. (London: Society for Promoting Christian Knowledge, 1918.) Price 2*s*. net.

IN these days, when, by the loom of science, strange and terrible patterns have been woven on our national life, and novel and improved designs are demanded on every side, it is refreshing to turn again to the history of one of the greatest pioneers in scientific discovery and renew our spiritual friendship with that "Just and Faithful Knight of God," Michael Faraday. The author of this little volume has done his work well, and given us a realistic picture both of the scientific enthusiast and of the humble and devout Christian. "Not half his greatness was incorporate in his science, for science could not reveal the bravery and delicacy of his heart." We could wish this book to be read by our legislators, by our manufacturers, and even by our educational authorities, in order to impress upon them "that research must be free to be powerful and that there is little to be gained from a servile science." Gradually but surely the ideas of Faraday have permeated physical science, and at no time since their publication have they met with such general acceptance as they do to-day. "It may fairly be claimed that modern English physics is the school of Faraday, applying his methods, led by his vision, inspired by his faith." H. S. A.

Cotton. By George Bigwood. ("Staple Trades and Industries," vol. ii.) Pp. viii+204. (London: Constable and Co., Ltd., 1918.) Price 6*s*. 6*d*. net.

THIS volume gives a readable, popular account of the whole field which the cotton industry includes, beginning with the historical records, and passing successively through the cotton fields, the mills, and the markets. The book is well printed and illustrated, but, especially on the technical side, it would be improved by a number of corrections when it reaches the second edition. L. 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 Supposed "Fascination" of Birds by Snakes and the "Mobbing" of Snakes by Birds.

I HAVE received the following interesting notes by Dr. J. Burton Cleland, of 93 Macquarie Street, Sydney. I may add to the observations recorded towards the end of his letter the behaviour of a common grey African parrot brought to this country as a young bird in 1904, and almost certainly without experience of hawks. One wing is clipped from time to time and the bird given much freedom in the garden. Twice I have seen it drop with a scream and crouch on the ground when an aeroplane has flown overhead at a rather low elevation.

EDWARD B. POULTON.

Oxford, February 11.

"Some twenty years or so ago, whilst walking in a garden in the outer suburbs of Adelaide, my attention was attracted by the behaviour of a small company of white-plumed honey-eaters (*Ptilotis penicillata*, Gld.). The individuals were making a considerable noise, and kept flying down to the lower branches of a carob-bean tree (St. John's Bread), where these overhung the pathway, and then up higher again, their attention being apparently attracted by an object on this path. The object proved to be a stock-whip, with long, snake-like lash and short handle. As thrown carelessly down the lash certainly suggested serpentine coils, and my impression, as noted at the time, was that they had probably mistaken the lash for a snake. Their behaviour was that manifested by other Meliphagidæ—for instance, *Myzantha garrula*, Lath.—in the presence of an enemy such as a bird of prey. The birds congregate together, make much noise, and fly about excitedly. In this way they may indicate the resting-spot of an owl disturbed from its sleeping-place by day.

"Several interesting points are worth considering. First, these honey-eaters had probably never seen a snake, though rarely an occasional one has been noticed in the neighbourhood. Secondly, as the birds spend their time near the tops of the eucalypts and build at the end of fine branches, and the snakes near Adelaide do not climb trees, even had they seen snakes these could have done them no harm. Thirdly, if my interpretation of their behaviour be correct, they recognised the 'snake' by its form alone, as no movement could take place. Though other unusual objects, but not snake-like in outline, must have been common in a large garden and its surroundings inhabited by children, the same fuss was not noticed to be made over them. From the above it would appear, provided their actions were rightly interpreted, that the birds or their immediate ancestors had probably never seen a snake, and had certainly never been subjected to danger from such; and that, therefore, the behaviour manifested, presumably to harass and drive away an enemy, must have been purely instinctive. In other words, on presentation to vision of, in this case, a motionless object of snake-like form, the brain-centres concerned with the methods of combating a foe were automatically stimulated, quite apart from the sensitising of such centres by previous individual experience.

"It is interesting to note here that the fowls in the poultry-run of the same house make a great noise and run for shelter when a hawk flies past through the trees, though none, so far as is known, had ever been attacked by hawks. Strange to say, another Australian bird, *Graucalus melanops*, Lath., may give rise to the same reactions, and I think I remember having noticed them also when one of the larger cuckoos (probably *Cuculus pallidus*, Lath.) flew overhead. Both these birds have peculiar flights, more hawk-like than those of pigeons, which, though about the same size, do not, in my experience, frighten poultry. The general form of the large cuckoo is also suggestive of a hawk like the kestrel (*Tinnunculus cenchroides*, Vig. and Horsef.). These reactions are again obviously purely instinctive, and not the result of personal experience."

The Shortage of Research Workers.

IN a paper recently read before the Royal Society of Arts on "The Government and the Organisation of Scientific Research," Sir Frank Heath directed attention to the dearth of skilled research workers, who are urgently needed to investigate industrial problems. All who have studied the question are agreed that in the near future the necessity for industrial scientific research will be greater than ever, and it may, therefore, be well to point out some preventable causes which are likely to make the situation worse instead of better.

During the war research departments have been established at most universities and colleges for special war purposes, and many capable workers have thus been discovered. At the present moment many of these departments are in process of demobilisation, and no concerted effort is being made to retain the services of those who have proved their worth as research workers, who are being allowed to find their way into other occupations. This waste of invaluable material is deplorable at the present juncture, and could be avoided by proper co-ordination between Government departments. A second matter, not so easily remedied, relates to the large number of scientific men who gave their services gratuitously during the war, but cannot be expected to continue this sacrifice in peace-time. No funds appear to be available for the provision of payment to such workers in case they are willing to take up industrial research in their spare time. Even when workers are willing to continue for some time longer on a voluntary basis, with the view of completing work in hand, it is not always possible to procure the small funds necessary for covering the expenses incurred in the work. The writer is acquainted with one research committee, dealing with problems of wide industrial application, which has been compelled to suspend its work owing to the withdrawal of funds by the Government department which financed its operations during the war. Nothing could be more deplorable at the present juncture than the discouragement of voluntary research, and in such cases immediate steps should be taken to provide funds from other sources.

The most disquieting feature, however, is the present financial condition of the universities and colleges from which the research workers of the future must be obtained. Whilst the cost of equipment has at least doubled, the incomes of these institutions have remained, in most cases, stagnant. This not only prevents the acquisition of adequate appliances for advanced teaching, but also debars the members of the staffs from obtaining the increases in salary rendered necessary by the increased cost of living. Many skilled teachers who have been on active service are declining to resume their pre-war appointments for this reason, and a serious shortage of capable instructors in advanced science is threatened. At present teachers of elementary science are better paid, on the average, than those engaged in the higher branches, and are additionally, in most cases, entitled to pensions under the Teachers' Superannuation Act. The obvious result of this anomalous state of things is that the ranks of higher scientific teachers will be depleted unless strong and prompt Government action is taken to place the universities and colleges on a sound financial basis. Unless this be done there is little prospect of obtaining the research workers necessary to secure the industrial future of the country.

CHAS. R. DARLING.

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The Indian Rope Trick.

THE recent correspondence in the *Daily Mail* relating to the Indian rope trick is very similar to the controversies that have arisen from time to time in the Press in India, but nothing said seems to advance the evidence a jot further. The man who does the rope trick has yet to be produced!

During a considerable portion of a residence of more than thirty years in India, I studied Indian conjuring and made all the inquiries I could regarding this trick. I knew many of the best conjurers between Calcutta and Delhi, but never found one who had seen the rope trick. Several had heard of it, some believed in it, none could satisfactorily explain it.

Personally, I am of opinion that the rope trick is entirely mythical. I decline to accept the various theories put forward by amateurs in support of its practicability, such, for example, as hypnotism or substitution. The most likely explanation I have heard is that the trick is performed in a courtyard, that smoke obscures the view above, and that the rope is actually thrown up to a confederate, who fastens it to a beam which cannot be seen on account of the smoke; a lad then climbs up the rope and is similarly lost to view in the smoke, but even this theory is unlikely. It would not be impossible to arrange a scene on a stage where the rope trick could be performed as an illusion—not by a smoke screen, but by other means of hiding what happens above a certain height.

As to Indian conjuring generally, I consider it to be far behind European, though the sleight of hand is often extraordinarily good, and the methods occasionally ingenious, as, for instance, when conjurers apparently cause a few grains of wheat or gram to sprout in a few moments—a far better illusion than the overrated mango-tree trick.

Indian conjurers are very conservative and seldom produce new tricks, and they are very slow in discovering how a trick, new to them, is done even when performed by an amateur on well-known principles.

G. HUDDLESTON.

Hemel Hempstead, Herts.

THE USE OF HELIUM FOR AIRCRAFT PURPOSES.

SHORTLY after the commencement of the war it became evident that if helium were available in sufficient quantities to replace hydrogen in naval and military airships, the losses in life and equipment arising from the use of hydrogen would be enormously lessened. Helium, as is known, is most suitable as a filling for airship envelopes, in that it is non-inflammable and non-explosive, and, if desired, the engines may be placed within the envelope. By its use it is also possible to secure additional buoyancy by heating the gas (electrically or otherwise), and this fact might possibly lead to considerable modifications in the technique of airship manœuvres and navigation. The loss of gas from diffusion through the envelope is also less with helium than with hydrogen, but, on the other hand, the lifting power of helium is about 10 per cent. less than that of hydrogen.

Proposals had been frequently put forward by men of science in the British Empire and in enemy countries regarding the development of supplies of helium for airship purposes, but the first attempt to give practical effect to these proposals was initiated by Sir Richard Threlfall, who received strong support from the Admiralty through the Board of Invention and Research, under the presidency of Admiral of the Fleet Lord Fisher.

It was known that supplies of natural gas containing helium in varying amounts existed in America, and it became evident from the preliminary investigations made by Sir Richard Threlfall, and from calculations submitted by him as to cost of production, transportation, etc., that there was substantial ground for believing that helium could be obtained in large quantities at a cost which would not be prohibitive.

Prof. J. C. McLennan was invited by the Board of Invention and Research in 1915 to determine the helium content of the supplies of natural gas within the Empire, to carry out a series of experiments on a semi-commercial scale with the helium supplies available, and also to work out all technical details in connection with the large-scale production of helium and the large-scale purification of such supplies as might be delivered and become contaminated with air in service. In this work Prof. McLennan received assistance from his colleagues, Profs. John Satterly, E. F. Burton, H. F. Dawes, Capt. McTaggart, and Mr. John Patterson.

In the course of their investigations, which were carried out with the co-operation of L'Air Liquide Co., it was found that large supplies of helium were available in Canada, which could be produced at a cost of about one shilling per cubic foot.

In the summer of 1917, when the United States of America had decided to enter the war on the side of the Allies, and after the investigations referred to above were well under way, proposals were made to the Navy and Army and to the National Research Council of the U.S.A. to cooperate by developing the supplies of helium available in the United States. These were made, on behalf of the Admiralty, through the Board of Invention and Research by Sir Ernest Rutherford and a special Commission consisting of Commander Bridge, R.N., Lt.-Col. Lowcock, and Prof. John Satterly.

The authorities cited agreed to co-operate with vigour in supporting these proposals, and large orders were at once placed by them with the Air Reduction Co. and the Lynde Co. for plant, equipment, cylinders, etc. The Bureau of Mines also co-operated in developing a new type of rectifying and purifying machine. By July, 1918, the production of helium in moderate quantities was accomplished, and from that time onward the possibility of securing large supplies of helium was assured.

Concurrently, all practical details of the production of helium-borne airships and of the navigation of this type of craft were developed by the airship production section of the Navy. At the same time, under the direction of Prof. McLennan, plans were prepared and steps taken to erect and equip a station for purifying the helium which might become contaminated in service. Experimental investigations were also initiated with the object of developing the possible technical and scientific uses of helium. In particular, balance and spectroscopic methods for testing the purity of the gas were worked out, studies on the relative permeability of balloon fabrics to hydrogen and helium were commenced, and experiments were begun to exploit the use of helium in gas-filled incandescent lamps, gas-filled arc lamps, and thermionic valves. The equipment provided for the purification of contaminated helium in large quantities supplied the major portion of the apparatus required to liquefy helium, and arrangements were therefore made to produce this gas in a liquid form.

The advances already made by the time the Armistice commenced warrants the opinion that at the end of another year large supplies of helium would have been produced within the Empire at a low cost, helium-filled aircraft would have been in service, and great progress would have been made in exploiting the technical and scientific uses of this gas.

Before the war a proposal to utilise helium as a filling for airships would have been viewed, even by men of science, as akin to a proposal at the present time to pave the Strand with diamonds. Thanks, however, to the enterprise, enthusiasm, and initiative of the Navy, backed by imagination, a suggestion—at one time considered to be chimerical—has to-day become a realisation.

BIRDS AND THE WAR.

WITHIN the limits of a short article it is not possible to do justice to our feathered friends. The services rendered by homing-pigeons to the Army, Navy, and Air Forces have been invaluable, and numerous stories of their gallantry and devotion, under fire and even when wounded, have already appeared in the daily newspapers. Canaries, long recognised as the miners' friends in detecting the presence of poisonous underground gases, have played their part in the war by being used in the trenches and dug-outs when the presence of German poison-gas was suspected. It is not so generally known that parrots, in the earlier days of the war, were employed on the Eiffel Tower to give warning of the approach of enemy aircraft. Sea-gulls, on more than one occasion, betrayed the presence of submarines and mines and thus prevented disaster to our sailors.

On the actual battlefield the behaviour of birds has been remarkable. Unperturbed by the terrible racket and the bursting of gas-shells, a nightingale trilled its sweetest, a soaring skylark poured out its song, a blackbird sang the more merrily the heavier the bombardment, swallows twittered around, and nested in, the battered ruins of Ypres Cathedral even when it was under fire; a "minnie-shell," which burst in the middle of a covey of partridges, did not alarm them and they went on feeding unconcernedly a few seconds later. In fact, it may be said that the birds, wherever they could eke out an existence, seemed oblivious to the life-and-death struggle going on all round them.

At home the consensus of opinion of trustworthy observers shows that birds were at first much upset by air raids. As these, however, became more frequent, their fears diminished. There can be little doubt that birds are adaptable creatures, and soon become accustomed to loud noises. As an example of this, it may be stated that when the bells of St. Paul's were rung, after a protracted silence, to celebrate "Armistice Day," the City pigeons, long unaccustomed to such sounds, appeared to be seriously alarmed, though in days of peace they paid no attention to the daily chimes.

The restrictions on food, imposed on all loyal citizens, made it an offence to feed birds and prosecutions ensued. A sportsman was fined for feeding pheasants on grain, and more than one kind-hearted person paid the penalty for feeding birds on scraps. Cage birds were difficult to keep, and never were parrots more freely offered on loan to the Zoological Gardens.

The strenuous orders issued to farmers to plough up the maximum amount of their land was followed by a misguided outcry against all birds. Thanks to the efforts of the Royal Society for the Protection of Birds, and a few reasonable ornithologists, the agriculturists were persuaded that, after all, the majority of birds do more good than harm. There are, however, several enactments made against birds (such as the extension of the period for burning heather, the prolongation of the shooting season for grouse and blackgame, and the "Destruction of Pheasants Order") which, it is to be hoped, will shortly be modified or repealed.

Reports are not yet to hand as to how birds fared in enemy countries; probably they were no better off than they were in Great Britain. Such items as have evaded the strict German censorship, regarding the shortage of food, tell us that rooks were sold and eagerly bought as articles of diet. It is amusing to note that a correspondence, carried on in one of our leading daily newspapers, as to the edibility of gannets, gulls, etc., was ingeniously interpreted by the German newspaper-men as showing that England was starving owing to the invincibility of the U-boats.

Migration does not appear to have been

affected; doubtless the travelling birds would be flying too high above the tumult of the battlefields to notice it and, even if they encountered a "barrage," they could always "rise to the occasion." Before aeroplanes became as common as they did towards the end of the war, birds were considerably excited by them. Gulls and wildfowl were observed to flee before them in panic-stricken rout, but on one occasion a flock of gulls is reported to have flown inquisitively after a seaplane. Incidentally, it may be noted that some interesting observations were made by our aviators as regards the height at which birds fly when on migration.

Perhaps the greatest effect of the war on bird-life in general will prove to be the lack of forests and woods. The abnormal felling of timber which has been carried out during the war must have an effect on arboreal birds for many years to come. The presence of the great spotted woodpecker in new areas in Scotland has already been announced, and is attributed to the fact that former haunts have disappeared under the axe. Owing to the absence of our gamekeepers an undeniable increase in "vermin" is widely reported. Jays seem to have been particularly numerous and widespread lately, and buzzards have been seen in many an unaccustomed place. But the benefits accruing from the lack of gamekeepers are not likely to be enjoyed for long.

Enough has been written to show that the subject of "Birds and the War" is one which demands more than a short article. I have compiled a book, now in the printers' hands, which deals (I think as fully as is at present possible) with the whole subject. Though I do not claim that my book attains finality, I trust that it may prove of some use to ornithologists, and also be of general interest; in any case, I offer it as a tribute to our friends the birds.

Hugh S. Gladstone.

PROF. G. CAREY FOSTER, F.R.S.

PROF. GEORGE CAREY FOSTER, whose death, on Sunday, February 9, at the age of eighty-three, we announced last week, was born at Sabden, in Lancashire. He received his education at University College, London, after which he proceeded to the Universities of Ghent, Heidelberg, and Paris. Carey Foster had held many official positions. He was appointed professor of experimental physics at University College at the age of thirty, his chair ultimately becoming the Quain chair, under the endowment of Sir Richard Quain. For four years, from 1900, he held the office of principal of the college. He was a fellow of the Royal Society, and one of its vice-presidents during the periods 1891–93 and 1902–3. He occupied the presidential chair of the Society of Telegraphic Engineers (now the Institution of Electrical Engineers), and also of the Physical Society of London. He was a fellow both of the University of London and of University College, and an honorary member of the Jewish Historical Society and of the American Philosophical Society.

In the last years advancing age compelled Carey Foster gradually to relinquish his official positions and to retire more and more into his country home. To the younger generation he is therefore known only by name, yet he played a leading part in at least three important movements connected with education in London.

First, in the eighties of last century, efforts began to be made to bring about an achievement of the aims of the original promoters of the foundation of the college as a university. Carey Foster (in his own words) looked upon the college not only as an important place of education, but also as an important expression of a most remarkable intellectual movement—"a movement which stood for free inquiry and effort towards improvement, intellectual and social." Education, untrammelled by extraneous considerations, could not be obtained in the days when his college was founded. Owing to the vicissitudes which the scheme met with, the teaching and examining functions of the institution had become distinct, the former being vested in the college, while the latter were carried on by the University as a separate body. Carey Foster threw himself, heart and soul, into, if he did not actually lead, the movement for the re-establishment of a teaching University in London, so that its teachers might have freedom in their teaching, untrammelled by the examinations of a distinct institution. This movement led to the establishment of the present University, which, however, only partly realised the wishes of its first promoters. In order still further to realise these aims, the college ultimately (January 1, 1907) allowed itself to be swallowed up in the University in order that it might, if possible, work the necessary reforms from inside. Carey Foster identified himself with the movement from first to last.

Next, still further to carry out the idea of emancipation, he was a hearty supporter of the projects for the admission of women to university teaching and privileges. Such a change was inevitable. It was regarded, in some quarters, as a hazardous step. Its extension within the college and to other colleges and universities in England and abroad is a justification of the pioneer work of the college.

The third movement was concerned directly with the teaching of the subject of which Carey Foster was professor. He laid the foundation of the physical laboratory as it exists to-day. When he himself was educated, laboratory work, as we now know it, did not form part of any curriculum. But, about 1866, in two rooms in his college, he created the first physical laboratory, in which students might repeat the standard methods of measurement which were then being rapidly developed—especially on the Continent—and be taught the conditions for success in such measurements. Cabinets of physical apparatus had existed before, but these were intended for the illustration of lectures. The spirit of change was in the air, and physical laboratories sprang up in many directions. At the present day lectures without laboratory work are a deadly anachronism, even for, or perhaps particularly for, junior men.

As a thinker, Carey Foster was somewhat hesitant in forming definitive opinions on philosophical and scientific theories. To this cause, no doubt, is due the comparative fewness of his publications. It did not seem logical to him to derive extensive theories from a few experimental observations. For this reason he postponed publication both in his own case and in that of his students. But a method of measurement was another matter, and his published extensions of Wheatstone's bridge method of measuring resistances and of the measurement of mutual inductances are remarkable for their neatness and value. His services on the Electrical Standards Committee of the British Association for the Advancement of Science, and on the Kew Observatory Committee of the Royal Society, prove the direction in which his bent really lay. His publications include an article in Watts's "Dictionary of Chemistry," and he was joint author of a text-book on electricity and magnetism. In the first edition of the latter he strove to develop the subject on the lines laid down by Maxwell, according to which the electrical actions in the æther are all-important; but in later editions he gradually yielded to the pressing claims to recognition of the very large number of new phenomena discovered in the last twenty years, which require a modification of the most extreme of Maxwell's conclusions.

In his writings Carey Foster had the mastery over a lucid and logical prose of a remarkable order. He was much sought after as a sage counsellor, for his kindly method of criticism disarmed resentment when his counsel was adverse. He lived at peace with all men, his main aim being, as expressed in his last Christmas greeting, "to do all which may achieve and cherish a just and lasting peace among ourselves and with all nations."

NOTES.

THE following announcement is made in the political notes of Tuesday's *Times*:—"Sir Watson Cheyne has been appointed chairman of the newly formed House of Commons Medical Committee, which consists of Members who possess a medical or surgical degree, or are interested in medical or scientific matters. The Committee will exchange views upon all proposed legislation which has relationship to any medical or allied question. The main object of these deliberations will be the avoidance, so far as possible, of the expression of conflicting medical or scientific views in Parliamentary debate. The Committee will also invite reports from, and hold conferences with, medical and scientific bodies. Major Farquharson is secretary to the Committee, and Sir William Whitla, Lt.-Col. N. Raw, and Capt. Elliott form the executive committee." As men of science are not sufficiently organised to secure seats for members of their own body in Parliament, they should be glad to know that members of the medical profession are willing to consider scientific as well as medical matters of national interest. We should not like to think, however, that scientific men, knowing the needs of the country and the service of progressive knowledge to civilisation, will be content to remain permanently without representation among our legislators. Medicine is only one branch of science, but, as things are at present, science is a department of medicine so far as Parliamentary action is concerned.

A VIGOROUS attack on the policy of the Board of Agriculture was made in the House of Lords last week by two noble lords, both of whom in the past have had some share in directing the operations of the department. Criticism was directed to a recent circular in which it was announced, *inter alia*, that what has been known during the war as the "ploughing policy" would no longer be actively prosecuted, and that efforts should be concentrated on improving the condition of the existing arable land rather than on adding to its area. Lord Ernle had no difficulty in parrying the attack. He pointed out that much of the increase of ploughed land had been secured at the expense of the effective tillage of the existing acreage, and that an increase in food production would be secured at least cost by thoroughly cleaning and conditioning the land already under the plough rather than by breaking up new areas of grassland—at best always a speculative operation. The ideal which the President of the Board of Agriculture has set before the farming community is a modest one, merely to raise the general standard of farming to the level of that attained by the best farmers in the adjoining district. It is not generally recognised how wide is the gap indicated, but instances could be given where the value of land has been quintupled by the application of scientific knowledge without moving adjoining farmers a hair's-breadth from the ruts of their outworn practice.

A LEADING article in the *Times* of February 17 states that the Prime Minister has agreed to receive a deputation on the subject of fisheries administration. It points out that the present position of our sea fisheries is anomalous and unsatisfactory, and that the establishment of a Department of Fisheries would remedy this, giving the fishermen one special department, instead of half a dozen, to deal with; improvement in transport, a better regulation and supervision of the fisheries, and other urgent matters, would then receive attention. In relation to the alternative proposal for a Ministry of Water, the *Times* remarks that the question of the use of water-power is very remote from that of food supply, nor is it more favourably disposed towards the scheme of State control propounded by the Empire Resources Development Committee. The following reference is made to the need for scientific investigation:—"An important branch of the work of the proposed Ministry would be the organisation of scientific research into the habits and movements of fish. Although the study of marine biology and kindred subjects has made great strides in the United Kingdom in the last few years, our scientific equipment is utterly unworthy of the greatest fishing nation in the world. We have been far outstripped by the United States and by Canada, the splendid sea-fish hatcheries of which put us to shame." With the first two sentences we fully agree, but with regard to the last we may remark that the utility of hatcheries is disputed, and that we have far less reason to feel ashamed when looking at the sea-fish hatcheries of the United States than when considering what we, whose fisheries are as important as those of the rest of Europe, have to set against the marine investigations of the Norwegian Hjort, the Danes Petersen and Johannes Schmidt, and the Dutchmen Redeke and Hoek.

THE Press of February 15 contained the full text of the scheme for a League of Nations, which had been unanimously accepted the previous day by the representatives of the fourteen Powers assembled at Versailles. This alliance of free States is based on the solid foundation of the confederacy that has defeated the autocratic Empires, and Germany and her satellites will be admitted to it only if and when they give evidence that they are sincerely disposed "to observe their international obligations and conform to such principles as may be prescribed by the League in regard to naval and military forces and armaments." As to the details of the scheme, they are of the nature of a sound working compromise between the projects of those who would have created an immediate super-State like the Holy Alliance of 1815 and the projects of those who would have been content with a restoration of the nineteenth-century Concert of Europe. The new international authority is to have a real control, exercised by means of an assembly of delegates, an executive council, and a permanent secretariat. At the same time its control is so limited in time and sphere that it does not interfere much more than existing treaty obligations do with the sovereign independence of the contracting States. It contemplates and makes provision for the employment of force, if necessary, in the vindication of its decisions. It insists on the publicity of treaties, though not of the process of negotiations. It wisely rejects the impracticable project of the creation of international armies and the establishment of international control over backward races, and substitutes the incomparably saner arrangement of mandatory Powers. In sum, the scheme is a hopeful and a workable one. Its preparation and its unanimous acceptance are excellent auguries both for the future work of the Conference and for the peace of the world.

A BILL to establish a Ministry of Health and a Board of Health to exercise in England and Wales, and in Scotland, respectively, powers with respect to health and local government, was presented to the House of Commons on February 17 by Dr. Addison and read a first time. The general powers and duties of the Minister of Health will be to take all such steps as may be desirable to secure the effective carrying out and co-ordination of measures conducive to the health of the people, including measures for the prevention and cure of diseases, the treatment of physical and mental defects, the collection and preparation of information and statistics relating thereto, and the training of persons engaged in health services. It is proposed to transfer to the Ministry (1) all the powers and duties of the Local Government Board; (2) all the powers and duties of the Insurance Commissioners and the Welsh Insurance Commissioners; (3) all the powers of the Board of Education with respect to attending to the health of expectant mothers and nursing mothers and of children who have not attained the age of five years and are not in attendance at schools recognised by the Board of Education; (4) all the powers of the Privy Council and of the Lord President of the Council under the Midwives Acts, 1902 and 1918; and (5) such powers of supervising the administration of Part I. of the Children Act, 1908 (which relates to infant life protection), as have heretofore been exercised by the Secretary of State.

BRITISH war-time propaganda, as directed by various Government departments ranging from the Ministry of Information to the Ministry of Food, ended at the Armistice with a spasmodic suddenness characteristic alike of its origin and of much of its conduct during hostilities. It was about the same time that other countries, notably the United States, redoubled their propagandist work to further the activities of peace. An example of the way in which this work is pursued by the United States was furnished by a correspondent of the *Times*, whose article appearing on February 11 described the "world's record advertising campaign" organised by the U.S. Government in South America. While the war was still in being a vigorous campaign, excelling the efforts of any other belligerent, had made South America fully aware of every phase of the United States war effort, and as a natural corollary of its plans for industrial construction, inventions, and so on. The information, supplied to newspapers free of charge and without any condition as to acknowledgment of its source, was prepared by practical newspaper men, who were well acquainted with a newspaper's need for "copy" that is exclusive, interesting, and novel. That was not all. If a newspaper wanted special information on United States industrial matters the representatives of the U.S. Public Information Committee in the large cities of South America were willing to cable for it and supply it. This is the kind of elastic and adaptable machinery which is very much wanted in Great and Greater Britain to enable the public to learn, and, above all, to make the public interested in learning, what is going on in British industries, in industrial science, discovery and invention. The Ministry of Information, joined to the Department of Scientific and Industrial Research, might have provided the machinery for some such distribution. At present the Board of Agriculture distributes leaflets and has its Journal, and the Board of Trade Journal also publishes for a public of its own. But what is needed is some organisation which, while having as its principal functions those of informing special publics at home and in the Dominions, should make it its business to get at the general public through the newspapers.

A RECURRENCE of influenza has set in over the British Isles. In the south of Ireland the renewed outbreak is said to be of a virulent type, and is particularly severe in parts of Kerry and Cork. The Registrar-General's return for the week ending February 8 shows a marked increase in the deaths from the epidemic, the number for the County of London being 100, which is greater than in any of the preceding six weeks. In the ninety-six great towns of England and Wales, including London, the deaths from influenza were 604, which is also greater than in any of the six preceding weeks. The deaths from pneumonia in London were 182, and from bronchitis 226, which is more than in any of the preceding nine weeks. For the last eight weeks the deaths from bronchitis have been more numerous than those from pneumonia; prior to this, pneumonia had the larger number of deaths.

A GENERAL Order has been issued by the Local Government Board making malaria, dysentery, trench fever, acute primary pneumonia, enteric fever, relapsing fever, and typhus fever notifiable as epidemic and infectious diseases under the Public Health Act. The Order, which applies to England and Wales, comes into force on March 1. "Dysentery" includes the amœbic and bacillary varieties of the disease, and "enteric fever" includes typhoid and paratyphoid fevers. In cases of malaria the medical officer may supply the patient with mosquito-netting if necessary, and provide for quinine treatment. A person suffering from dysentery may be required to discontinue any occupation connected with the preparation or handling of food or drink for human consumption. In cases of trench fever the medical officer may require steps to be taken to obtain the complete destruction of lice on the person and clothing of every occupant of the building. The powers conferred under the new Order should be of considerable value in the control of the diseases named, some of which are almost new to Britain.

THE death of Mr. Stephen Reynolds at Sidmouth on February 14, in his thirty-eighth year, deprives the country of one whose work for British fisheries will not soon be forgotten. As adviser on inshore fisheries to the Development Commission, and resident inspector of fisheries for the south-western area, Mr. Reynolds's practical knowledge and sympathetic interest have been of the utmost value in developing the fisheries of Devon and Cornwall, and the gap caused by his death will be difficult to fill. Mr. Reynolds was a B.Sc. of the University of Manchester, and studied at the Ecole des Mines in Paris, but ill-health led him to change his plans for a career, and in 1903 he became associated with the Woolley Brothers, fishermen, at Sidmouth, with one of whom he worked for several years. He was thus brought into close contact with the problems of English fisheries and fishermen, whose interests he eloquently advocated in many articles and other writings. The movement in favour of the further development of inshore and longshore fisheries was initiated by Mr. Reynolds, practically as the result of a remarkable series of articles in the *Times* of February 7, 10, and 17, 1912. These were followed by the appointment of Mr. Cecil Harmsworth's committee consisting of members of Parliament, and then by the Departmental Committee on Inshore Fisheries, which reported in April, 1914, and of which Mr. Reynolds was a member. The outbreak of war prevented legislation based on the report, but special activities—those of the Fish Food and Motor Loan Committee—were directed to the increased productivity of the smaller fisheries, and Mr. Reynolds took a prominent part in the practical working out of the schemes promoted under the Board of Agriculture and Fisheries. He was a most zealous inspector, and knew his district and men as no one else did. Though not a scientific investigator himself, he was still alert to any discoveries, and keen to apply them. He was widely human in his outlook on the fishing industry, thinking far more of the fishermen than of the material side of their occupation. He possessed philosophic insight into the results of modern scientific investigation, and a year or two ago had developed a system which applied to mental evolution Bergson's *élan vital*. It is to be regretted that he was unable to publish this work.

LT.-COL. SIR MARK SYKES, Bart., M.P., whose death occurred in Paris on February 16, in his fortieth year, made a close study of peoples and customs of the East, and was the author of several notable works upon them. His latest volume, "The Caliph's Last Heritage," published in 1915, is largely concerned with his travels in Asiatic Turkey in 1906–13, and covers a wide field in Syria, Mesopotamia, Kurdistan, Asia Minor, Turkish Armenia, and a journey in Lower Egypt. His personal narratives are full of vigour and reality, often highly and truly picturesque, and constantly enlightening. Among Sir Mark Sykes's other works are "Through Five Turkish Provinces" and "Dar-ul-Islam: Five Mansions of the House of Othman." He mapped the north-west region of Mesopotamia and the desert south of Jerusalem, and in the course of his travels made road-maps of five thousand miles of road previously unmapped in Asiatic Turkey. His intimate knowledge of Eastern peoples was of great value, and many will regret that the Empire should be deprived in these times of a statesman of his understanding and capacity.

SIR ROPER LETHBRIDGE, whose death at the age of seventy-nine is announced, occupied an important position in the Indian educational service, and, on his retirement, in English public life. After a distinguished career at Oxford he was appointed Government professor of political economy in the University of Calcutta, became secretary of the Education Commission in 1877, and then held the post of Political Agent. Sir Roper Lethbridge was best known in India as Press Commissioner for the supervision of the vernacular Press. He made a particular study of Imperial Preference as it affected India. On his return to England he became Member of Parliament for North Kensington, and held many public offices, among them president of the Devonshire Association and member of the Exeter Diocesan Board of Education. Sir Roper Lethbridge possessed a wide knowledge of Indian affairs and of English public life.

MR. THOMAS CLARKSON has been elected president of the Institution of Automobile Engineers for the ensuing year.

SIR OLIVER LODGE will deliver the Friday evening discourse at the Royal Institution on February 28 at 5.30 p.m. on "Ether and Matter." Owing to indisposition, Prof. J. A. McClelland will be unable to deliver his discourse on "Nuclei and Ions," as announced.

AT the annual meeting of the Malacological Society of London, held on February 14, Mr. G. K. Gude was elected president in succession to Mr. J. R. le B. Tomlin. Mr. Gude has for the past nine years filled the office of hon. secretary of the society.

WE learn from *Science* that the National Geographic Society has presented the Hubbard gold medal to Mr. V. Stefansson, whose explorations during the last five and a half years in the Arctic regions have resulted in the reduction of the unknown polar regions of the western hemisphere by approximately 100,000 square miles.

THE death is announced, in his fortieth year, of Dr. W. Erskine Kellicott, professor of biology at the College of the City of New York. Dr. Kellicott had previously held for several years a similar chair at Goucher College, Baltimore, and from 1908 to 1917 was director of the Marine Biological Laboratory at Woods Hole, Massachusetts. He had written several books on evolution, embryology, and kindred subjects.

WE regret to note that the death of Mr. George Pauling is recorded in *Engineering* for February 14. Mr. Pauling was the senior partner in the firm of Pauling and Co., Ltd., which constructed the whole of the Rhodesian railways, in addition to many miles of line in other parts of South Africa. From 1894 to 1896 he served as Minister of Mines and Public Works in Rhodesia, and was also a member of the Executive Council.

THE following officers and council of the Royal Astronomical Society were elected at the annual general meeting on February 14:—*President:* Prof. A. Fowler. *Vice-Presidents:* Sir F. W. Dyson, Astronomer Royal, Dr. J. W. L. Glaisher, Major P. A. MacMahon, and Prof. H. F. Newall. *Treasurer:* Mr. E. B. Knobel. *Secretaries:* Dr. A. C. D. Crommelin and Rev. T. E. R. Phillips. *Foreign Secretary:* Prof. H. H. Turner. *Council:* Prof. A. E. Conrady, Dr. J. L. E. Dreyer, Prof. A. S. Eddington, Brig.-Gen. E. H. Hills, Mr. J. H. Jeans, Dr. Harold Jeffreys, Mr. H. S. Jones, Lt.-Col. H. G. Lyons, Mr. E. W. Maunder, Dr. W. H. Maw, Prof. J. W. Nicholson, and Lt.-Col. F. J. M. Stratton.

SIR ARTHUR EVANS has presented to the British Museum the magnificent collection of ancient British and other Celtic coins made by his father, the late Sir John Evans. This collection, containing more than 1700 pieces, has long been famous, and by its acquisition the museum collection, already strong, is placed in a position far in advance of any similar assemblage. In addition to the Celtic coins, the gift includes a valuable Gaulish and Iberian series. Sir Arthur Evans, in the letter in which he announces this splendid gift, explains that, "as regards the ultimate destination of the ancient British collection, my father, realising the claims that might weigh with me on another side, has left me absolute discretion. I feel, however, that in presenting the collection to your department I am fulfilling his most intimate wishes. It is, moreover, a fitting tribute to his memory that it should be permanently connected with the museum, to the welfare of which, as trustee, he had so long and actively devoted himself." The British Museum is to be congratulated on a splendid acquisition, which will always be associated with the eminent antiquaries by whom it has been preserved.

AN article entitled "The Crucial Question of Patents," by Sir Robert Hadfield, published in the *Engineering Review* for December last, directs attention to the defects of our Patent Law and its practice, and, at the same time, makes certain recommendations with the object of improving matters. Whilst unanimity in opinions prevails in relation to the desirability of introducing some of the reforms proposed by Sir Robert Hadfield, different views exist as to certain of the other proposals. For instance, many inventors feel that the introduction into this country of the United States "file wrapper" system, which provides for the arguments of the examiners dealing with applications being open to inspection by the public generally, is likely to prove injurious to their interests, and may give an unfair advantage to capitalists in negotiations for the purchase of patent rights from inventors or their agents. Similarly, a great number of inventors do not view with favour any widening in the present functions of the Patent Office, so as to permit it to adjudicate, before making a grant, upon the relative merits of rival claims; yet it is only in this way that effect could satisfactorily be given to the proposal that the department which grants the protection should guarantee its validity. Again, as regards the proposal made to increase the original term of the patent from fourteen to seventeen years, having in view the fact that inventions are of many kinds, some being simple and requiring little expenditure to place on the market, whilst others are complex and require much time, skill, and capital to develop, the modification in the law likely best to meet the needs of the situation would seem to be that which would facilitate the grant of an extension for varying terms according to the particular merits of the invention and the nature of the difficulties which had been overcome by the inventor, the original term of fourteen years established by long usage being retained as at present. There is a consensus of opinion that the need for reform in our Patent Law is pressing, and that action in relation thereto should be taken by the Government without delay.

IN the January issue of *Man*, Mr. J. Reid Moir describes two Late Bronze age urns found near Manningtree, in North Essex, and at Ipswich. That recently discovered in the latter locality contained fragments identified by Prof. Keith as calcined human bones. Both these specimens were obviously cinerary urns. They are distinguished by a peculiar form of decoration, a series of pittings all over the surface, which seems to be characteristic of the type of a similar kind found in Essex.

CAPT. A. T. H. NISBET gives a description of the conditions found in amputation stumps by means of X-ray examination, removal of which is necessary before an artificial limb can be fitted. These include abscesses, pieces of dead bone, inflamed nerve-ends, inflammation and inflammatory outgrowths of the bone, and adherent scars. For the examination he recommends the use of a moderately soft X-ray tube, as it brings out the abnormalities more clearly than other forms of tube (*Archives of Radiology and Electrotherapy*, No. 222, January, 1919, p. 237).

THE Hunterian oration was delivered on February 14 at the Royal College of Surgeons by Major-Gen. Sir Anthony Bowlby. "Surgery in the Field" formed the subject of the oration, and it was shown how improved methods had been introduced with consequent saving of life. Thus in the earlier stages of the war gas-gangrene was prevalent, but in 1917–18 out of 25,000 patients at the base hospitals only 84 had serious gas-gangrene. Each year of the war had seen better surgical methods, better results, lessened suffering, and the saving of lives and limbs in constantly increasing numbers.

Symons's Meteorological Magazine for January is the index number for the preceding year; it completes the fifty-third volume. A short notice is given of the rainfall of 1918. In addition to the usual matter comprised, including the map of the Thames Valley rainfall, there is an article on "The Congress of Scandinavian Geophysicists in Gothenburg, August 28 to 31, 1918," by Dr. Hans Pettersson. It is stated that a highly representative congress of about fifty Danish, Norwegian, and Swedish geophysicists met. Prof. Hildebrandsson, of Upsala, was elected president, and Director Ryden, of Denmark, Prof. Bjerknes, of Norway, and Prof. Nordenskjold, of Sweden, were chosen as vice-presidents, Dr. Hans Pettersson being general secretary. Amongst the papers read at the general and sectional meetings were "Weather Forecasting," by Prof. Bjerknes, describing a new method of short-range prognostics for agricultural purposes in West Norway, based on synoptic observations chiefly of the wind, the percentage of the correct forecasts being stated as between 85 and 90. There were also papers on "Hydrographical Observations on the West Coast of Greenland," on "Some Observations of the Aurora Borealis," and on "Weather Forecasting for Airmen." In all, thirty papers were read. It is intended to call together a second congress in due course. The same issue also contains the conclusion of a series of articles on "Work and Water-power," by Dr. H. R. Mill. The statistics accumulated by the Rainfall Organisation are necessarily of high value in determining requisite factors. Dr. Mill says:—"In this country it may be said, roughly, that the proportion of the natural water-power which it would pay to utilise depends on the price of coal. As the cost of fuel rises, it becomes worth while to draw on sources of water-power which, from remoteness or cost of works, could never pay while coal is cheap."

IN connection with a review in NATURE of January 9 of Dr. Silberstein's "Simplified Method of Tracing Rays through any Optical System," the author of the book has written to make an offer that should appeal to persons engaged in optical design. The reviewer suggested that there was some doubt as to the practical utility of the vectorial method of ray tracing, and expressed the desirability of further information on this point. Dr. Silberstein writes:—". . . In order to help the spread and the easy handling of the vector method, in the spirit of Dr. Brodetsky's closing sentence, I shall be glad to do personally all in my power to remove doubts and apparent difficulties. In this respect half an hour's personal conversation is certain to be more efficient than many hours dedicated to the writing of notes or papers for publication. The former has, moreover, the obvious advantage of being adaptable to the individual needs of the questioner. In order to meet, in part at least, these needs, I gladly offer myself to give free information on the subject in question to everybody who will care to call personally (not by letter) at 4 Anson Road, Cricklewood, London, N.W.2, where I shall be available for that purpose *on every Friday from* 5.30 *until* 7.30 *p.m.*" We have much pleasure in making public Dr. Silberstein's offer, and feel that some of our readers will gladly avail themselves of this unique opportunity of being initiated into the practical application of vector methods by a master of the subject. At the same time we suggest that Dr. Silberstein would be doing a service to a wider circle of those interested in optical work if he were to publish one or two detailed computations based on his formulæ.

THE following works are in the press for publication by the Carnegie Institution of Washington:—"The Duration of the Several Mitotic Stages in the Root-tip Cells of the Onion," H. H. Laughlin; "Contributions to the Genetics of the *Drosophila melanogaster*," T. H. Morgan, C. B. Bridges, and A. H. Sturtevant; "The Genetic and Operative Evidence Relating to Secondary Sexual Characters," T. H. Morgan; and "Studies of Heredity in Rabbits, Rats, and Mice," W. E. Castle.

OUR ASTRONOMICAL COLUMN.

LUMINOSITIES AND DISTANCES OF CEPHEID VARIABLES.—In continuation of his important studies of stellar clusters, Dr. Harlow Shapley has investigated the luminosities, distances, and distribution of the Cepheid variables (*Astrophys. Journ.*, vol. xlviii., p. 279). Restricting the discussion to variables with definitely determined periods of less than forty days, there are forty-five stars which are of the "cluster" type and ninety-four ordinary Cepheids with periods greater than a day. The absolute magnitudes and parallaxes have been determined by means of the luminosity-period relation, with an average probable error estimated at 20 per cent. The cluster-type variables are found to have absolute luminosities a little more than one hundred times the brightness of the sun, while the ordinary Cepheids range from two hundred to ten thousand times that of the sun. Fewer than one-third of the stars have parallaxes greater than a thousandth of a second, and the most distant Cepheids now known are nearly 20,000 light-years from the sun. While the ordinary Cepheids are strongly concentrated towards the galactic plane, the cluster-type variables are indifferent to that plane. The wide dispersion of the latter may probably be accounted for by their relatively high velocities in space.

RADIAL VELOCITIES OF 119 STARS.—A preliminary account of the radial velocities of 119 stars, as determined at the Cape Observatory, has been given by Dr. J. Lunt (*Astrophys. Journ.*, vol. xlviii., p. 261). The number of these stars which probably have constant velocities is seventy-six, while the remaining forty-three are either known or suspected spectroscopic binaries. Eighteen of the stars in the first class were very frequently observed in connection with the spectroscopic determination of the solar parallax, the total number of plates obtained for them being 552. The following are among the results for some of the bright stars, as compared with the values obtained at the Lick Observatory:—

Star	Radial velocity Cape km.	Lick km.
α Arietis	−15·3	−14·0
α Tauri	+54·0	+55·1
α Can. Min.	− 3·6	− 3·5
β Geminorum	+ 3·2	+ 3·9
α Hydræ	− 4·6	− 3·5
ε Virginis	−14·3	−13·2
α Boötis	− 5·3	− 3·9
α Serpentis	+ 2·9	+ 3·4
λ Sagittarii	−43·4	−43·1
α Aquarii	+ 6·8	+ 7·5

Approach to the sun is indicated by a *minus* and recession by a *plus* sign.

"ANUARIO DEL OBSERVATORIO DE MADRID."—This useful annual for 1919 contains all the customary astronomical data, including the times of rising and setting of the moon (which might with great advantage be inserted in our own Nautical Almanac). There are also several essays; one, by A. Vela, gives a *résumé* of researches on the temperature of the sun's photosphere, concluding in favour of 7000°. C. Puente shows how to find time and latitude from the observed altitudes of two stars; this can be solved graphically by the well-known Sumner method. Dr. F. Iñiguez, the director of the observatory, gives an interesting monograph on Nova Aquilæ, with photographs of the spectrum from June 9 to September 4, and a light-curve, which appears to show that the period of variation was about twelve days in July, but more than a month in August and September.

Very full details are given of the sun-spots and prominences observed at Madrid in 1917; also the results of observations of solar radiation between 1917 September 1 and 1918 August 31.

The remainder of the volume is occupied by the meteorological observations of 1917.

THE CHEMISTRY OF SEAWEEDS.

THE scarcity of potash compounds, of iodine, and of foodstuffs caused by the great war has directed increased attention to seaweeds during the past four years, and to the possible extension of the use of these as a source of such materials. For some years before the war the giant seaweeds of the Pacific Coast were the subject of systematic investigation in the United States, especially with a view to their utilisation as a source of potash. After the outbreak of war, when many countries, including the United States and the countries allied against Germany, were cut off from their usual supplies of potash compounds from the German mines, examination began to be made of all sources from which potash might be obtained independently of Germany, and seaweeds came in for an increased amount of attention.

If we consider the great supplies of seaweed which are available, especially in the case of an insular country like our own, with a long and deeply indented coast-line, it is remarkable how little has been done, either from the purely scientific or from the industrial point of view, for the thorough and systematic exploration of the chemistry of seaweeds. A criticism by Prof. C. Sauvageau,[1] of Bordeaux, of

[1] "Réflexions sur les Analyses Chimiques d'Algues Marines." *Revue Générale des Sciences*, 29e Année, No. 19, October, 1918.

the analytical work which has been carried out to determine the chemical composition of marine algæ brings out clearly how incomplete and scrappy is our knowledge of the chemical composition of these plants, and how untrustworthy and unscientific is much of the work which has already been done.

Prof. Sauvageau reviews what has been done in France, Britain, and the United States during recent times, and especially during the past thirty years, in the analysis of seaweeds, and he is specially severe on some of his own countrymen for their ignorance of botanical nomenclature and for the contempt with which they treat natural science, as shown by their failure to learn the rudiments of the language of botany before undertaking to deal with a botanical subject. Much of this criticism is just, and some of the examples given of the use of out-of-date and inexact nomenclature are sufficiently serious to show that it was necessary. While thus dealing faithfully with his own countrymen, Prof. Sauvageau recognises that some chemists have taken the trouble to identify with sufficient care the species which they have analysed. Thus he says that "the accuracy with which Stanford names the plants studied inspires more confidence in the reader than the uncouth appellations of Allary." He also recognises that American workers like Wheeler and Hartwell have taken care to obtain competent assistance in identifying the species they have examined.

At the same time Prof. Sauvageau appears to underestimate the difficulty in which the careful chemist who wishes to identify and name his species correctly sometimes finds himself. He himself offers a good illustration of this difficulty in his reference to the present writer's recent work on the composition of five of our commonest seaweeds collected on the coast of Scotland. Two of these belonged to the genus Laminaria, and are similar both in their appearance and structure and in their habitat. There is no difficulty to one who takes the trouble to make himself familiar with them either in distinguishing these species, or in recognising from Prof. Sauvageau's own description that what is called in my papers *L. digitata* is what he calls *L. cloustonii*, and that what I analysed under the name *L. stenophylla* he calls *L. flexicaulis*. But standard works of reference which were consulted were not agreed as to these names, which I used only after reference to a distinguished botanical colleague; and to make as certain as possible that there should be no mistake as to what species were intended, a standard work on seaweeds in accordance with which these names were used was referred to in one of my papers. Nevertheless, Prof. Sauvageau writes:—"His *L. stenophylla* is probably a mixture of that which English botanists call *L. digitata* (*L. flexicaulis*) and *L. stenophylla*, that being a close ally, if not a variety, of *L. flexicaulis*." He himself does not appear to be clear either as to the nomenclature of English botanists or as to the species which were identified with so much care. He can scarcely expect the chemist to do more than accept the best botanical guidance to be obtained on a point of this kind where, he admits, the practice of botanists is not uniform.

Another criticism which Prof. Sauvageau offers of the work of chemists is also valuable, and requires careful attention from the chemist, but again one cannot help thinking he would have been more effective if he had not attempted to press his criticism too far. He points out that if the analyses are to have a scientific, and not merely an industrial, value, not only should species be properly identified, but also samples collected for analysis should be clean and biologically pure, and obtained, if possible, from the actual habitat, with a careful record of the season, the condition of growth, and the state of the plants, whether fertile or sterile. All these are important points which have too often been neglected. The large common seaweeds are frequently garnished with a great variety of other organisms, both animal and vegetable, making it difficult to procure even a reasonably pure sample. In some cases these foreign organisms can be removed, but it is generally difficult to remove them entirely. It also introduces errors, as great in many cases as those which are being avoided, if attempts are made to wash the samples, as compounds which properly belong to them are also removed in the wash-water. All that one can do is to collect reasonably pure samples and to pick off all the foreign organisms which can be distinguished. In many cases, however, the chemist was not attempting to analyse a pure botanical species, but to determine the composition of the impure substance used for some industrial purpose, such as the drift-weed which is washed up on the beach, and used as manure or for kelp-burning. The value of such analyses is limited by the object in view.

Prof. Sauvageau has performed an important service in directing the attention of chemists to the precautions which they require to take when they enter on the systematic study of the composition of seaweeds or of any other species of plant. Our knowledge of the composition of seaweeds is still quite rudimentary, and very valuable work might be done in this field by chemists with a competent knowledge of the botany of seaweeds, or working in collaboration with botanists who would collect and identify the samples for analysis. The recorded analyses show wide variations in the composition of seaweeds of the same species, and Prof. Sauvageau is inclined, on account of this, to cast doubt on the samples or on the conditions under which they were collected. In the present state of our knowledge this is scarcely justified. Numerous well-authenticated cases of similar wide variations in composition are found in the case of other plants, even when they appear to be grown under similar conditions in the same locality and are collected at the same stage of growth.

JAMES HENDRICK.

ITALIAN CLIMATOLOGY.

TWO more contributions by Prof. F. Eredia to our knowledge of the climate of Italy have recently appeared, one dealing with the normal mean values of annual rainfall in Italy, and the other with diurnal temperature variation in Sicily. In the first paper, "Le Medie normali della quantita' di Pioggia in Italia" (*Giornale del Genio Civile*, anno lvi., 1918), the mean values for each calendar month are shown for nine well-distributed cities on the basis of the fifty-year period 1866–1915; and it is calculated that the values are correct to within 5 mm. for the rainier winter months and 9 mm. to 12 mm. for the summer months of smaller rainfall and more irregular distribution. In northern or continental Italy, as exemplified by Milan and Turin, the seasonal variation of rainfall is not prominent, but the wettest periods are early summer and autumn, the highest figures being for May and October. In peninsular Italy the typical Mediterranean feature of wet winters and dry summers is conspicuous, especially in the extreme south. Thus at Palermo the figure for December, the wettest month, is 108 mm. (4·3 in.), and for July, the driest, only 7 mm. (0·28 in.). The wettest city quoted is Genoa, on the Ligurian coast, where the wettest month, October, has 190 mm. (7·6 in.), and the driest, July, 47 mm. (1·9 in.); and here also the winter, as a whole, is considerably rainier than the summer.

The other paper, "La Variazione Diurna della Temperatura a Catania e a Messina" (*Bollettino dell' Accademia Gioenia di Scienze Naturali in Catania*, fascicolo xliv., Luglio, 1918), shows that, excepting the months of June, July, and August, which have practically identical mean temperatures at Messina and Catania, ranging between 22° and 26° C. (72° to 79° F. *circ.*), the latter place is distinctly colder. The greatest difference is in January, when the mean for Catania is 9·5° C. (49·1° F.), and for Messina 11·6° C. (52·8° F.). The difference is attributed to the fact that for the major portion of the year Mount Etna, being snow-clad, exerts a chilling effect upon the air at Catania, rendered the more marked from the circumstance that the prevailing wind direction is N.W. at both places. Thus the wind at Messina blows straight in from the warm sea surface, but blows down on Catania from the snows of Etna. The mean diurnal range of temperature is greater at Catania in every month of the year except August, the greatest difference occurring in November. In this month the daily range is 5·1° C. at one place and 2·9° C. at the other, or a difference of 2·1°. The regulating action of the sea is thus more marked at Messina. At both places the diurnal range of temperature is small, but, as is very generally the case, greater in summer than in winter.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Lord Moulton, of Christ's College, honorary fellow of St. John's College, has been appointed Rede lecturer for the present year.

Mr. A. Hopkinson, of Emmanuel College, has been appointed additional demonstrator of human anatomy for five years.

Capt. J. T. Saunders, formerly junior fellow of Christ's College, has been elected to a senior fellowship, and Capt. C. G. Darwin, lecturer in mathematics at the college, to a junior fellowship. Capt. Saunders is University demonstrator of animal morphology, and Capt. Darwin was bracketed Fourth Wrangler in 1909.

OXFORD.—By the death of the late Provost of Oriel, Dr. C. L. Shadwell, the University has lost a well-known and characteristic figure. Though but slightly in sympathy with many of the movements and aspirations of present-day Oxford, Dr. Shadwell gained universal respect by the acutely legal turn of his mind, by his remarkable business ability, and by the devotion with which he threw himself into the public affairs of both University and city. A life-long advocate of education on a wide and general basis, he yet found time and opportunity to become a master in many departments of curious and specialised learning, often surprising his hearers by the sudden display of some unusual piece of erudition. These *dicta* were delivered with a characteristic incisiveness, and not without a suggestion of latent and kindly humour. Amongst his accomplishments was a wide and thorough knowledge of botany, which he turned to account as a curator of the botanic garden. For the last four years he had been living in retirement, but his loss will be deeply felt by his own college and by the University at large.

On February 18 a decree was introduced by the Warden of Wadham providing for the acceptance by Convocation of an offer by the trustees of the Christopher Welch benefaction to provide 450*l.* a year each for five years for a lecturer in clinical physiology and in economic zoology respectively. Mr. H. C. Bazett, fellow of Magdalen College, and Mr. N. Cunliffe, Trinity College, Cambridge, were appointed lecturers, these being the first appointments made under the Welch bequest.

At the same meeting of Convocation the report for 1918 of the Committee for Rural Economy was presented, recording, amongst other items, that a farm of 355 acres at Sandford-on-Thames had been secured on lease for the purpose of providing facilities for experiments and demonstrations in connection with the work of the School of Agriculture and Forestry.

THE Regional Association—an organisation for the promotion of regional research—is arranging for a vacation meeting at Malvern from April 9 to April 16. All further particulars can be obtained from the hon. secretary, Mr. Geo. Morris, 7 West Road, Saffron Walden.

WE learn from the *Times* that at a meeting of the Edinburgh University Court, on February 18, a letter was read from the Treasury intimating that an advance of 7000*l.* by way of a grant from the Development Fund would be made to the University in aid of the endowment of a chair of forestry on the condition already accepted by the University—that the remaining 7000*l.* required was provided by the University from other sources. The Court resolved to institute a chair.

SIR ERNEST CASSEL has placed in the hands of trustees a sum of 500,000*l.* for the following educational purposes:—(1) The promotion of adult education in connection with the Workers' Educational Association or any other association or body approved of by the trustees. (2) The establishment of scholarships for the encouragement of the education of workmen or their sons and daughters. (3) The promotion of the higher education of women by the assistance of colleges for women. (4) The promotion of the study of foreign languages. (5) The establishment of a faculty of commerce in the University of London in such terms as may be approved by the trustees. The trustees are Mr. Asquith, Mr. Balfour, Miss Philippa Fawcett, Mr. H. A. L. Fisher, Lord Haldane, Sir George Murray, and Mr. Sidney Webb; their secretary is Mr. A. E. Twentyman, 6 Stanhope Gardens, Highgate, N.6.

ANNOUNCEMENT is made that the general committee of Lloyd's Register of Shipping will grant the following scholarships for the study of naval architecture and marine engineering:—Three scholarships in naval architecture at Glasgow, Durham, and Liverpool Universities, tenable for three years; three scholarships in marine engineering at the University of Liverpool, tenable for three years; and two scholarships in marine engineering in connection with the Institute of Marine Engineers, tenable for two years. The regulations governing the scholarships have been amended in order that the field of competition may be widened. Before 1915 five scholarships were competed for each year, and were of a value of 50*l.*; the committee has resolved to increase this amount to 100*l.*, and since no scholarships have been awarded during the past three years, and also that probably there will be a larger number of candidates offering themselves than has hitherto been the case, to authorise the grant of more than one scholarship to each institution for the present year, provided the authorities can recommend that such a course can be adopted with advantage. Full particulars of the qualifications and details of the subjects of examination can be obtained from the Secretary, Institute of Marine Engineers, 85–88 The Minories, Tower Hill, London, E.1.

In 1914 the Education Committee of the City of Coventry had made all arrangements for erecting a technical institute, which, with equipment, was estimated to cost 40,000*l.* The war prevented the scheme being carried out, and the expansion of the city during the war has been such that the scheme has had to be entirely rejected as inadequate. The site selected being too small, it was necessary to find another. There is every prospect of a better site being obtained, with the additional advantage that there will be ample provision for extensions when the necessity for these arises. The Education Committee has approached the Chamber of Commerce with the view of obtaining assistance to make the new technical college worthy of the city. The Chamber of Commerce has treated the proposal very sympathetically, and will probably give material help in providing for the cost of the equipment; 50,000*l.* is the sum mentioned. Messrs. Alfred Herbert, Ltd., have given an impetus to the scheme by a very generous gift of 5000*l.* towards the equipment, and it is confidently expected that the other firms in Coventry will be relatively as generous. It is gratifying to note that the manufacturers, as a rule, take a keen interest in the technical education of their employees, and the interest shown by the Chamber of Commerce will probably lead to active co-operation between the Education Committee and the manufacturers. It is estimated that the whole scheme will cost between 100,000*l.* and 120,000*l.*

At a meeting of the Committee for the Furtherance of University Education in South-West England, held at Exeter on January 27, a report was given of the recent deputation to the President of the Board of Education to urge the matter. The deputation sought for the approval of the Government for the scheme of a university for the South-West, which should comprise colleges at Exeter, Plymouth, Newton Abbot, and Camborne, each doing the type of work suitable to its own locality. No fewer than ninety-one publicly elected councils have supported the scheme, and more than 250 Labour organisations are in favour. In reply, Mr. Fisher pointed out that in the university proposed for the South-West it appeared that the several faculties were to be widely separate from one another. Mining would be located at Camborne, agriculture at Newton Abbot, engineering and marine biology, and possibly commerce, at Plymouth, and the humanities and pure science at Exeter. In regard to finance, he felt that it would be difficult to establish a first-rate university of the South-West with the funds which at present seemed likely to be available. The number of university students would depend upon the development of secondary education in the area from which the university would draw. The 10,000 pupils given as the number in the secondary schools of the area concerned might be expected to yield rather fewer than 700 university students, and with some 200 of these probably going to Oxford or Cambridge, there would scarcely be enough left to justify the creation of a South-Western University. He would be very glad to see a really effective university set up in the West of England, but at the present moment, and in view of existing circumstances, he did not think that there was a sufficient promise of students, teachers, or financial support to justify the establishment of a degree-giving body in the two western counties, and that before such a step could be properly taken a good deal of preliminary work had still to be accomplished, not only in the sphere of secondary education, but also in the development of the higher forms of education at both Exeter and Plymouth. With these views before it, the committee decided to direct the executive committee to invite representatives of the governing bodies of University College, Exeter, Seale-Hayne College, and the Cornwall School of Metalliferous Mining, as well as the education authorities of the South-West, to confer with them in regard to the prospects of the further development of such institutions.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 6.—Sir J. J. Thomson, president, in the chair.—A. **Mallock**: Note on the elasticity of metals as affected by temperature. The present note is an account of some preliminary experiments on the variations with temperature of Young's modulus for fifteen selected metals. The choice was influenced largely by the ease with which specimens could be procured. No alloys are included. The metals chosen were rhodium, platinum, iron, palladium, nickel, copper, gold, silver, magnesium, aluminium, zinc, lead, cadmium, bismuth, and tin. The procedure was to determine the frequency of the vibrations of a stiff rod carried at its lower end by a small thin plate of the material to be tested, the other end of the plate being clamped to a fixed support. The plate and its support could be immersed in fluid of any desired temperature without wetting the rod or in any way interfering with the mounting. The temperatures employed were those of liquid air, 0° Centigrade, ordinary temperature (10°–15°), and as near 100° C. as was practicable. The measured frequencies of vibration at these temperatures furnished the necesary data for determining the changes in Young's modulus. The results showed that the more infusible the metal, the less the modulus was affected for a given change of temperature, and this suggested that there might be a real connection between the variation of the modulus (M) and the melting point θ_M in Absolute temperature. A diagram is given comparing the experimental results with what they would have been had the relation $dM/d\theta=\theta_M$ been true. If this relation holds, and θ_1, θ_2 are two temperatures for which the moduli are M_1, M_2, then would

$$M_1/M_2=\overline{\theta_M-\theta_1}/\overline{\theta_M-\theta_2},$$

and if θ_1 is Absolute zero and $\theta_2=0°$ C., then in this case $M_1/M_2=\dfrac{\text{melting point Absolute}}{\text{melting point Centigrade}}$ for any two temperatures differing by 270° C. The experimental results show a distinct resemblance to those obtained on this supposition.—W. L. **Cowley** and H. **Levy**: Vibration and strength of struts and continuous beams under end thrusts. In a previous communication, "The Critical Loading of Struts and Structures," the authors investigated the stability of a strut under end thrust and simply supported at a number of intermediate points. The method of analysis has been extended in the present paper to include the more general problem of the vibration of such a system when the lateral load is periodic and the supports are assumed in a state of vibration. The flexural rigidity and the end thrust, constant along each bay, are taken for further generality to vary from bay to bay. These conditions correspond closely with those originated in a wing spar of an aeroplane when in flight and influenced by engine-throbbing. A very general form of the equation of three moments is derived, and the conditions for resonance and crippling are expressed in a convenient determinantal form. The general case where the end thrust, the flexural rigidity, and the mass per unit length vary between the supports according to any assumed law is discussed, and the method of solution illustrated in the particular case of the crippling of a strut of variable flexural rigidity. The result is expressed in a form extremely convenient for graphical treatment.—A. **Dey**: A new method for the absolute determination of frequency. (With a prefatory note by C. V. Raman.)

Aristotelian Society, February 3.—Prof. T. P. Nunn, hon. treasurer, in the chair.—Prof. H. Wildon **Carr**: Philosophy as monadology. The monad is a substance conceived as an active subject owning its activities, and not as a substratum of qualities or attributes. Monads are a mental or spiritual order not to be confused with physical atoms, which are an external order. In ordinary experience we find it necessary to regard the world from two points of view: (1) as an extended sphere of activity in which space, time, and matter are common to all subjects, and (2) as a private universe existing only for, and reflected into, one individual subject. Monads are windowless. This negative attribute is not a defect, but a positive character distinguishing the monadic order from the atomic. Every centre of life or consciousness possesses the unity of a subject of experience, and every change of its state is wholly within itself. No monad by intercourse parts with its substance or deprives another monad of its substance. There are not monads and atoms. When we view existence as a monadic order there are no atoms; when we view it as a system of external relations, atoms, there are no monads. The two orders, though each effacing the other, are not of equal validity. Monads alone are real; atoms are an abstract view of reality for a practical end.

Physical Society, January 24.—Prof. C. H. Lees, president, in the chair.—S. **Skinner**: Notes on lubrication. Experiments on the pressure of air in the neighbourhood of a flywheel running in contact with a flat tangential board are described to exhibit the properties of a compressible lubricant. A comparison of the compressibilities and viscosities of the vegetable and mineral oils leads to the conclusion that the special property of "oiliness" is the physical property of incompressibility. In note ii. Worthington's experiments on the adhesion of two solids immersed in a stretched liquid are explained as an illustration of the phenomena of lubrication in a stretched liquid. In note iii. the effect of glass beads, etc., in promoting the free boiling of air-free water is explained by the occurrence of cavitation behind the moving beads, etc., the steam entering the cavities thus produced and dilating them into large bubbles.—Prof. W. B. **Morton**: Sir Thomas Wrightson's theory of hearing. The theory seeks to explain the power possessed by the ear of analysing into its component tones a compound aerial disturbance. It assumes (1) that impulses act on the mechanism of the ear corresponding with the maxima and minima of the compound vibration-curve, and also with the points where the curve crosses the axis; (2) that among the spacings of these impulse-points there is a preponderance of intervals which approximate to the periods of the component tones, their lower octaves and their combination tones, and that these spacings determine the sensations of the component tones. The present note is concerned with the second of these assumptions. Graphs are drawn which exhibit the way in which the distribution of impulse-points varies when relative intensities and phase-relation of the component notes are changed. Difficulties are found in (1) the large number of other spacings presented to the ear, (2) the variations of the spacings with loudness-ratio and phase relation, and (3) the fact that in a single pure tone the spacing is a quarter of the period of the vibration.—Dr. A. **Russell**: Electrical theorems in connection with parallel cylindrical conductors. Many problems in connection with parallel cylindrical conductors occur in practical electrical work. The formulæ for the capacity between the conductors and for the effective inductance are well known, but the values of the capacity and potential coefficients and of the inductance coefficients have not yet been determined. It is shown that for the case of a cylinder inside a cylindrical tube their values can in all cases be easily computed. When the cylinders are external to one another it is proved that the three capacity coefficients are connected by two very simple relations. Limiting values between which these coefficients must lie are found, and methods of obtaining closely approximate values in special cases are given. Practically identical formulæ enable us to find the current density and the inductance coefficients with high-frequency currents, both for a cylinder inside a cylindrical tube and for two parallel cylinders. In the latter case it is shown that when the phase difference between the currents is less than 90°, the mechanical force between the cylinders is repulsive when they are close together and attractive when they are far apart. At a definite distance apart, therefore, the cylinders when carrying high-frequency currents are in stable equilibrium. Since the potential coefficients can always be determined experimentally, it follows that the inductance coefficients for high-frequency currents, which are equal to them, are also found by the same experiments.

Royal Anthropological Institute, January 28.—Sir Hercules Read, president, in the chair.—Sir Hercules **Read**: Presidential address: War and anthropology. The president dealt with some of the scientific problems that confronted the institute as a consequence of the war, and suggested that it would be good for the institute, as well as for the world at large, if such societies were to take up the consideration of the physical well-being of the people regarded from every side. He referred first to the research work that had been done by his predecessor, Prof. Keith, in regard to the change in shape of the jaw and face contours of the British race in consequence, to some extent, of improper diet. He insisted upon the great importance of such investigations, and upon the duty that lay upon the Government to take measures to prevent degeneration owing to neglect of the obvious measures that would put a stop to such a decline. The institute had done excellent work in the establishment of a Bureau of Anthropometry, a branch of investigation that had been put to practical use in the Army, and no doubt numberless records had accumulated during the last four years. These would be of very great value as a demonstration of the physical condition of the British population, and in particular of the great gain that had resulted to the youths during their period of training—a period generally of very short duration, but of enormous benefit to the recruit. The president strongly advocated the continuance of such training, insisting upon the obvious advantages to the race on the physical side, and holding as strongly to the view that if in the course of training the youth could at the same time attain to the condition of being able to defend himself and his belongings against any aggressor, it would be an added advantage. Sir Hercules then dealt briefly with the difficulties connected with the Government scheme for the housing of the people, especially in relation to the healthiness of the proposed dwellings.

Zoological Society, February 4.—Dr. S. F. Harmer, vice-president, in the chair.—Sir Douglas **Mawson**: Australasian, Antarctic, and sub-Antarctic life. A large series of lantern-slides was exhibited, illustrating the scenery, mammals, and birds of the South Polar zone. The author commented on the urgent need of international measures to preserve the fauna of these regions.

Mathematical Society, February 13.—Mr. J. E. Campbell, president, in the chair.—Prof. H. S. **Carslaw**: Diffraction of waves by a wedge of any angle.—T. C. **Lewis**: General or non-orthogonal pentaspherical co-ordinates.

MANCHESTER.

Literary and Philosophical Society, February 4.—Mr. W. Thomson, president, in the chair.—R. S. **Adamson** and A. McK. **Crabtree**: The herbarium of John Dalton. The paper consisted of a short account of the history of the collection and of Dalton's botanical work. Some of the more important points of botanical interest in the collection were dealt with.

PARIS.

Academy of Sciences, February 3.—M. Léon Guignard in the chair.—M. Pierre Viala was elected a member of the section of rural economy in succession to the late A. Muntz.—A. **Angelesco**: Two extensions of algebraic continued fractions.—E. **Maillet**: The gradually varied movement and the propagation of bores.—L. **Décombe**: Sadi Carnot and the principle of equivalence of heat and work; his calculation of the mechanical equivalent of heat reconstituted with the aid of data taken exclusively from the "Réflexions sur la puissance motrice du feu." Following Clausius, the reproach has frequently been made against Carnot that he adopted the material theory of heat, but it should not be forgotten that this was done with serious reserves, and this is shown by passages from his memoir. In the manuscript notes of Sadi Carnot, quoted in full, is a series of objections to the material theory of heat, followed by a formal enunciation of the principle of equivalence, in the following terms:—"From some ideas which I have formed on the theory of heat, the production of one unit of motive power necessitates the destruction of 2·70 units of heat." This figure of Carnot leads to 370 kg. for the mechanical equivalent, as against the 365 kg. given at least ten years later by Mayer. Carnot also sketched out a programme of experiments practically identical with those carried out fifteen or twenty years later by Joule, Colding, and Hirn.—MM. **Gutton** and **Touly**: Non-deadened electric oscillations of short wave-length. The apparatus, which is described in detail and with a diagram, furnishes waves of less than two metres in length, and the harmonic vibrations are extremely small.—G. **Claude**: A new application of viscosity. An account of the use of a very viscous liquid in connection with the recoil of artillery. A diagram shows the increased accuracy of shooting obtained by this method of control when compared with the gun in current use.—P. **Gaubert**: Liquid crystals of agaricic acid.—P.-W. **Stuart-Menteath**: The tectonic of the Pyrenees.—A. **Nodon**: Researches on a new method of meteorological prediction. The method is based on the connection between the visible disturbances of the solar surface, electrical and magnetic disturbances on the earth, and those of the atmosphere.—M. **Mirande**: The chondriome, the chloroplasts, and the nucleolar corpuscles of the protoplasm of Chara.—M. **Marage**: The timbre of the voice in the partially deaf.

WASHINGTON, D.C.

National Academy of Sciences, November, 1918 (Proceedings, vol. iv., No. 11).—L. B. **Arey** and W. J. **Crozier**: The "homing habits" of the pulmonate mollusc Onchidium. *O. floridanum* lives during high tide in "nests," *i.e.* rock cavities, containing a number of individuals. The individuals leave the nest in low water to feed, and return simultaneously to it before the tide rises again, giving evidence of homing behaviour.—W. J. **Crozier**: (1) Growth and duration of life of *Chiton tuberculatus*. The growth-curve is obtained on the assumption that the age of a Chiton may be estimated from the growth-lines upon its shell. The mean duration of life is probably a little less than eight years. (2) Growth of *Chiton tuberculatus* in different environments. Growth-curves obtained under different conditions are compared.—C. **Barus**: The interferometry of vibrating systems. The high luminosity of the achromatic interferences and the occurrence of but two sharp fringes make it possible to utilise them even in cases when the auxiliary mirrors vibrate. The vibration interferometer is quite sensitive, provided the average currents are of the order of several micro-amperes.—Sir Joseph **Larmor**: The essence of physical relativity. A general discussion of the physics underlying relativity, with particular reference to an article by Leigh Page.—C. **Barus**: Gravitational attraction in connection with the rectangular interferometer. The rectangular interferometer is so sensitive in the measurement of small angles that it may be used for the measurement of the Newtonian constant of gravitational attraction.—W. P. **White**: The general character of specific heats at high temperatures. The general law covering the behaviour of atomic heats from the lowest temperatures up demands that at sufficiently high temperatures all atomic heats at constant volumes should have the value 5·96. A contrary hypothesis has been made, namely, that atomic heats continue to increase with the temperature. The substances here examined give evidence that the atomic heats do increase above the value 5·96.—G. M. **Green**: Certain projective generalisations of metric theorems, and the curves of Darboux and Segre. The continuation of earlier work by the same autnor in the Proceedings.—C. **Barus**: The rectangular interferometer with achromatic displacement fringes in connection with the horizontal pendulum.

BOOKS RECEIVED.

Astrographic Catalogue, 1900·0, Hyderabad Section. December $-16°$ to $-21°$. From photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of R. J. Pocock. Vol. ii. Measures of Rectangular Co-ordinates and Diameters of 61,378 Star-images on Plates with Centres in December $-18°$. Pp. xlix+218. (Deccan, India: Nizamiah Observatory, 1918.) 16*s.* net.

Annuaire Astronomique et Météorologique pour 1919. Par Camille Flammarion. 55e année. Pp. 364. (Paris: Librairie Ernest Flammarion, 1919.) 3.50 francs.

Meddelanden Från Statens Skogsförsöksanstalt. Häfte 15. Pp. 288+xxxii. (Stockholm: Aktiebolaget Nordiska Bokhandeln, 1918.) 4.50 kronor.

Essays and Discourses. By Sir P. Chandra Rây. With a biographical sketch and a portrait. Pp. xxxii+349. (Madras: G. A. Nathesan and Co., 1918.) 3 rupees.

Organic Thio-compounds, with Special Reference to Tautomeric Changes and the Formation of Polysulphonium Derivatives. Part i. By Sir P. Chandra Rây. Pp. iii+70. (Calcutta: The University, 1919.)

Traitement des Psychonévroses de Guerre. Par G. Roussy, J. Boisseau, and M. d'Oelsnitz. Pp. 191. (Paris: Masson et Cie, 1918.) 4 francs.

Mirrors, Prisms, and Lenses: A Text-book of Geometrical Optics. By Prof. J. P. C. Southall. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 3.25 dollars.

Recent Advances in Physical and Inorganic Chemistry. By Dr. A. W. Stewart. With an introduction by Sir William Ramsay. Third edition. Pp. xv+284. (London: Longmans, Green, and Co., 1919.) 12s. 6d. net.

Recent Discoveries in Inorganic Chemistry. By J. Hart-Smith. Pp. x+91. (Cambridge: At the University Press, 1919.) 4s. 6d. net.

The Great War Brings it Home. The Natural Reconstruction of an Unnatural Existence. By John Hargrave ("White Fox"). Pp. xvi+367. (London: Constable and Co., Ltd., 1919.) 10s. 6d. net.

The Voice Beautiful in Speech and Song: A Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. By Ernest G. White. New and enlarged edition of "Science and Singing." Pp. viii+130. (London: J. M. Dent and Sons, Ltd., 1918.) 5s. net.

The Cultivation of Osiers and Willows. By W. P. Ellmore. Edited, with introduction, by Thomas Okey. Pp. x+96. (London: J. M. Dent and Sons, Ltd., 1919.) 4s.

The Theory of Modern Optical Instruments. A Reference Book for Physicists, Manufacturers of Optical Instruments, and for Officers in the Army and Navy. Translated from the German by Dr. A. Gleichen, H. H. Emsley, and W. Swaine. With an Appendix on Rangefinders. Pp. xii+376. (London: H.M.S.O., 1918.)

Mikrographie des Holzes der auf Java Vorkommenden Baumarten, im Auftrage des Kolonial-Ministeriums. Unter leitung von Prof. J. W. Moll. Bearbeitet von Dr. H. H. Janssonius. Fünfte Lieferung. Pp. 337–764. (Leiden: E. J. Brill, 1918.)

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Prof. H. M. Lefroy: Insect Enemies of our Food Supplies.

ROYAL SOCIETY, at 4.30.—Jean Dufrenoy: Note on the Metabolism of the Glucosides of the Arbutin Group.—S. S. Zilva and F. M. Wells: Dental Changes in the Teeth of the Guinea-pig produced by a Scorbutic Diet.—W. E. Bullock and W. Cramer: A New Factor in the Mechanism of Bacterial Infection.—Major W. J. Tulloch: The Distribution of the Serological Types of *B. tetani* in Wounds of Men who received Prophylactic Inoculation, and a Study of the Mechanism of Infection in and Immunity from, Tetanus.

INSTITUTION OF MINING AND METALLURGY, at 5.—S. J. Truscott: Slime Treatment on Cornish Frames: Supplements.—Edwin Edser: The Comparison of Concentration Results, with Special Reference to the Cornish Method of Concentrating Cassiterite.—C. W. Gudgeon: The Giblin Tin Lode of Tasmania.—G. F. J. Preumont: Wolfram Mining in Bolivia.

LINNEAN SOCIETY, at 5.—C. E. Salmon: Drawings of British Orchids and Sea Anemones, by Mr. T. A. Stephenson.—R. H. Burne: Specimens of Sound-producing Organs in Invertebrates and Fishes.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

CHEMICAL SOCIETY, at 8.—R. G. Fargher and F. L. Pyman: Nitro-, Arylazo-, and Amino-glyoxalines.—J. Knox and M. B. Richards: The Basic Properties of Oxygen in Organic Acids and Phenols; and the Tetravalency of Oxygen.—W. N. Rae: Note on the Action of Chlorine on Tetramethyl Ammonium Iodide.

FRIDAY, FEBRUARY 21.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

ROYAL INSTITUTION, at 5.30.—A. T. Hare: Clock Escapements.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting. —*Resumed Discussions*: T. T. Heaton: Electric Welding.—H. Cave: The Development of the Oxy-acetylene Welding and Cutting Industry in the United States.—J. H. Davies: Oxy-acetylene Welding.—F. Hazledine: Oxy-acetylene Welding.

SATURDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 3.—Hon. J. W. Fortescue: The Empire's Share in England's Wars—Western Europe.

MONDAY, FEBRUARY 24.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. J. A. Fleming: Scientific Problems of Electric Wave Telegraphy.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Lt.-Col. H. S. L. Winterbotham: Geography with the British Armies in France.

TUESDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—Capt. G. P. Thomson: The Dynamics of Flying.

ROYAL SOCIETY OF ARTS, at 4.30.—E. J. Duveen: Key Industries and Imperial Resources.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—F. J. Mallett: The Flow of Water in Pipes and Pressure Tunnels.—A. A. Barnes: Discharge of Large Cast-iron Pipe-lines in Relation to their Age.

ILLUMINATING ENGINEERING SOCIETY, at 8.—A. Cunnington: Some Notes on Railway Lighting and its Maintenance.

WEDNESDAY, FEBRUARY 26.

ROYAL SOCIETY OF ARTS, at 4.30.—W. L. Hichens: The Wage Problem in Industry.

GEOLOGICAL SOCIETY, at 5.30.—Lieut. E. H. Pascoe: The Early History of the Indus, Brahmaputra, and Ganges.

ROYAL AERONAUTICAL SOCIETY, at 8.—Capt. F. S. Barnwell: Some Points on Aeroplane Design.

THURSDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Prof. H. M. Lefroy: How Silk is Grown and Made.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Hon. R. J. Strutt: Scattering of Light by Solid Substances.—Sir James Dobbie and Dr. J. J. Fox: The Constitution of Sulphur Vapour.—Dr. W. G. Duffield, T. H. Burnham, and A. H. Davis: The Pressure upon the Poles of the Electric Arc.

CHILD-STUDY SOCIETY, at 6.—Dr. P. B. Ballard: The Claim of the Individual Child.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. S. F. Barclay and Dr. S. P. Smith: The Determination of the Efficiency of the Turbo-alternator.

FRIDAY, FEBRUARY 28.

PHYSICAL SOCIETY, at 5.—Philip R. Coursey: Simplified Inductance Calculations, with Special Reference to Thick Coils.—Dr. Ralph Dunstan: Demonstration of Some Acoustic Experiments in Connection with Whistles and Flutes.—G. A. Brodsky: Demonstration of a New Polariser.

ROYAL INSTITUTION, at 5.30.—Sir Oliver Lodge: Ether and Matter.

SATURDAY, MARCH 1.

ROYAL INSTITUTION, at 3.—Hon. J. W. Fortescue: The Empire's Share in England's Wars—Eastern Europe.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

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UNEMPLOYED CHEMISTS.

In connection with the demobilisation and resettlement of Chemists who have been serving with the Forces, or otherwise engaged in war work, the Institute of Chemistry has issued notices through the Press asking companies and firms who wish to employ qualified analytical, research, or works chemists to communicate with the Registrar of the Institute, who will assist in filling vacant posts with suitable men. The notices state that "where appointments at salaries of £300 a year and upwards (with prospects) are offered, a good selection of candidates may be expected." A representative of the *Daily Chronicle* was told, "Ask us to-day for 200 chemists at £300 per annum, and we can provide them to-morrow."

The effect of these widely circulated announcements, coming from a body with the status and authority of the Institute of Chemistry, must be to make £300 the standard *maximum* salary which employers will offer, and which a fully qualified and trained chemist can expect to obtain. This sum, equivalent to a pre-war salary of less than £150, is not only a miserably inadequate remuneration for the services rendered by the chemist, but is not even sufficient to enable him to maintain a decent standard of life, much less to incur the expenses which are necessary for him to continue the scientific development on which the future of the nation depends.

Besides publicly sanctioning the notorious underpayment of a professional class which has given services of inestimable value to industry, the nation, and humanity, the Institute is undertaking to help employers to perpetuate the deplorable conditions under which our scientific work has hitherto been carried on.

In the interests not only of professional men of science, but also of national welfare and progress, the Executive Committee of the National Union of Scientific Workers feels that it is necessary to raise the strongest possible protest against the notices quoted above, and requests that the Press will assist in giving this protest a publicity equal to that of the Institute's announcements.

ERIC SINKINSON,
on behalf of the Executive Committee of the National Union of Scientific Workers.

February, 1919.

KEBLE COLLEGE, OXFORD.

NATURAL SCIENCE SCHOLARSHIP, 1919.

An examination will be held in this College on March 11 for a SCIENCE SCHOLARSHIP of the annual value of £60, with laboratory fees £20.

Subjects: Chemistry *or* Biology, with elementary Physics, and for Biologists elementary Chemistry as well.

Intending candidates should apply to Dr. HATCHETT JACKSON, the Science Tutor, for information.

UNIVERSITY OF EDINBURGH.

SUMMER SESSION, 1919.

FACULTY OF MEDICINE.

Applicants for admission to the Classes of the First Year during the Session which opens on April 15, who have not previously matriculated, are requested to send in their names to the DEAN of the Faculty of Medicine not later than March 8.

L. J. GRANT, Secretary.

NORTHAMPTON POLYTECHNIC INSTITUTE,

280 ST. JOHN STREET, LONDON, E.C.1.

TECHNICAL OPTICS DEPARTMENT.

Applications are invited for the position of DEMONSTRATOR in the OPTICAL LABORATORIES; whole-time appointment. Commencing salary, £180 per annum. For conditions and other information, apply to

R. MULLINEUX WALMSLEY, Principal.

DUDLEY EDUCATION COMMITTEE.

TECHNICAL SCHOOL.

Principal—A. COULSON, B.A., M.Sc.

WANTED at once, SCIENCE LECTURER for Day and Evening Classes. Knowledge of Engineering subjects an advantage. Commencing salary £250 per annum. Further particulars can be obtained from the PRINCIPAL. Forms of application can be obtained from the undersigned, and should be returned not later than Tuesday, March 4.

J. M. WYNNE,
Director of Education.

Education Offices,
Dudley.

THE TECHNICAL INSTITUTE, LOUGHBOROUGH.

Applications are invited for the post of LECTURER in MECHANICAL ENGINEERING, at a commencing salary of £250 per annum, with increments of £25 per annum up to £300, subject to satisfactory service.

Further particulars and forms of application may be obtained from the PRINCIPAL. These must be returned to the College before March 12.

WELLINGTON SCHOOL, SOMERSET.

ENGINEERING MASTER required in May next. Practical knowledge in Electricity and Magnetism, and workshop experience in Metal work essential. Apply HEADMASTER, Wellington School, Somerset.

LINEN INDUSTRY RESEARCH ASSOCIATION.

Applications are invited for the post of DIRECTOR OF RESEARCH for the Linen Industry Research Association. Candidates should state their scientific and other qualifications, such as administrative, industrial, &c., and furnish the names of three references.

The functions of the selected candidate will be to make a survey of the entire field of Research in the Linen Industry from the growing of the flax to the completion of the finished product, to draw up a programme of Research, to organise the scheme, and to supervise its carrying out.

A salary of not less than £1000 a year is offered. Further particulars and the Prospectus of the Association may be obtained from the SECRETARY, 3 Bedford Street, Belfast.

THE SOUTH AFRICAN SCHOOL OF MINES AND TECHNOLOGY, JOHANNESBURG.

(UNIVERSITY OF SOUTH AFRICA.)

The Council invites applications for the following positions:—

(1) PROFESSOR OF ANATOMY;
(2) PROFESSOR OF PHYSIOLOGY.

In each case the salary will be £1000 per annum, and the appointments will, in the first instance, be on two years' probation. The Professors will be full-time teachers. £75 will be allowed to each Professor for travelling expenses to South Africa, and half salary will be paid from the date of sailing until arrival in Johannesburg.

The Professors should arrive in Johannesburg about the end of July, 1919, to organise their Departments for starting teaching in March, 1920. It may be possible to do some preliminary work in Anatomy with first-year medical students towards the end of 1919.

Applications, in triplicate, stating age, professional qualifications and experience, as well as information regarding publications or researches, should, with copies of three recent testimonials, be sent by March 22 to the undersigned, who will supply further information if desired. Before appointment the selected applicants will be required to pass a medical examination.

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UNIVERSITY OF OXFORD.

PROFESSORSHIP OF EXPERIMENTAL PHILOSOPHY is vacant. Subjects: Mechanics, Sound, Light, and Heat. The Professor will have charge of the Clarendon Laboratory.

Annual stipend £900. Applications to REGISTRAR, University Registry, Oxford, by March 31.

UNIVERSITY OF OXFORD.

DR. LEE'S PROFESSORSHIP OF CHEMISTRY is vacant. Subjects: Inorganic and Physical Chemistry. Annual stipend £900. Applications to REGISTRAR, University Registry, Oxford, by March 31

THE ROYAL TECHNICAL COLLEGE, GLASGOW.

DEPARTMENT OF ELECTRICAL ENGINEERING.

Two ASSISTANTS wanted. Salary (1) £200 to £300; (2) £150 to £175. Applications, stating age, training, and experience, with any testimonials and references, should be sent to the PROFESSOR OF ELECTRICAL ENGINEERING before March 31.

BIOCHEMIST, accustomed to microscopical work, wanted for a year (or more) to co-operate in Bee-Disease Investigation. £350. Apply before March 15, with two references or testimonials, to the SECRETARY of the University, Aberdeen.

DEMOBILISED OFFICER, B.Sc., A.R.C.Sc.I., seeks evening work, teaching or otherwise, Mathematics, Physics, Mechanics.—Box 188, c/o NATURE Office.

LADY CHEMIST, graduate, wanted for Chemical Laboratory.—Apply CHIEF INSPECTOR, West Riding Rivers Board, Wakefield, stating present salary.

LABORATORY ASSISTANT REQUIRED (Woman) with knowledge of Chemistry, able to take charge of lecture experiments and general laboratory work.—Box 187, c/o NATURE

WANTED, a first-class MICROSCOPE for Bacteriological Research work. Stand must be by well known makers and of recent date, with good optical equipment and polarising apparatus.—State full particulars and price to J. LOMAX, Oakenbottom, Tonge, Bolton.

THURSDAY, FEBRUARY 27, 1919.

THE PROFESSION OF CHEMISTRY.

THE professional status of the medical practitioner is clearly established by definite legal enactments; the public, therefore, has no difficulty in recognising those who alone are entitled to act as saviours of its health. Lawyers are almost equally clearly marked out as a class apart. But in other cases the lines of demarcation are very indefinite. Thus the term "engineer" is applied equally to the members of the engineering profession—whose standing is established through their connection with certain recognised institutions—and to the craftsman who is simply a skilled manual workman.

The term "chemist" is one of even greater vagueness. It is not only used by those who, in one form or another, are engaged in the practice of chemistry; also, through long usage, it is associated in the public mind with the apothecary, druggist or pharmacist, who both dispenses drugs in accordance with medical prescriptions and is the salesman of a considerable variety of proprietary articles. Although pharmacy is an organised, protected calling, the sale of drugs is no longer confined to registered pharmacists but is an open trade, provided always that a qualified assistant be employed in dispensing. Another class is now coming into existence, viz. the specially qualified body of apothecaries or pharmacists attached to hospitals throughout the country; these are skilled in the principles of pharmacology and in the use of drugs.

It is being recognised that, in the interests of this latter body, as well as in those of pharmacology generally, a clear distinction should now be made between the honourable calling of pharmacy and that of the chemist proper; in fact, that it would be generally advantageous to dissociate the term "chemist" from the term "pharmacist," especially as the three distinctive titles of apothecary, druggist and pharmacist are all at the disposal of those engaged in the calling of pharmacy. But, even were this distinction made, the term "chemist" would still cover far too wide a range to admit of any simple definition, beyond that of a person more or less acquainted with the principles of the science and more or less skilled in their application—ranging from the professor, in close contact with progressive knowledge, to those employed in works laboratories in carrying out some routine testing operation, such as the determination of carbon in steel, the one being a man who is a highly skilled observer and worker and has learnt to think broadly, the other merely a craftsman skilled in the exercise of certain operations.

With rare exceptions, the line of demarcation, in future, must depend upon the training received. The profession should include all those who occupy certain recognised academic positions, together with those whose course of training has been of sufficient breadth and depth to justify their admission into the Institute of Chemistry, which is clearly marked out as the main avenue of approach. Now that the Institute is recognising the evils of our examination system and is prepared to grant membership to those who can produce satisfactory proof that they have passed creditably through the necessary course of training, so that it no longer seeks to interfere with the freedom of the schools, those who have the ability and aspire to be reckoned members of the profession should have no difficulty in securing entry. No one will gain—least of all the profession of chemistry—from the recognition of any other than a high qualification. But, as unconventional, if not irregular, methods of study may sometimes be attended with better results than regular, it will be desirable to keep an avenue open to those who prove themselves to be competent, should they desire to receive official recognition.

The recent establishment of a Federal Council for Pure and Applied Chemistry, to advance, safeguard and voice the interests of chemical science, marks a step forward of great importance to the Chemical Profession. It is taken advisedly, with the object of focussing opinion and of bringing about an affiliation of interests. At present the council consists of delegates appointed by the Chemical Society, the Society of Chemical Industry, the Association of British Chemical Manufacturers, the Institute of Chemistry, the Society of Public Analysts, the Faraday Society, the Biochemical Society, the Iron and Steel Institute, the Institute of Brewing, the Society of Dyers and Colourists, the Society of Glass Technology and the Ceramic Society. In all these chemistry is of primary importance, though not in every case the dominant interest.

The chairman is Sir William Pope, president of the Chemical Society and professor of chemistry in the University of Cambridge; and Prof. H. E. Armstrong is the hon. secretary.

One of the first cares of the new council will be to promote the formation of an association or guild of the societies specially engaged in furthering the interests of chemical science and to provide adequate quarters for the conjoint labours of the various sections. A complete library for the common use of chemists will be one of the chief features of this scheme. The step was one that was urgently called for to give dignity to the profession of chemistry and to secure for it the recognition it may justly claim from the public; it was also essential if the work of British chemists was to be carried on at the high level at which it must be maintained to meet our Imperial needs.

If we are not mistaken, the position of British chemical science is now reassuring. Gradually, during the war, the nation has been made aware that chemists have played an all-important part, both offensive and defensive; people are also more or less alive to the fact that industries in which the chemist is the leading spirit have been greatly developed. As a consequence, the popular feeling that English chemists were inferior to German has disappeared. It is certain, moreover, that the view put forward, notably by Prof. Carl Duisberg—the leading mind of the great Bayer firm—at the Perkin celebration in London, that his countrymen inherit peculiar aptitudes which must give them supremacy as chemical manufacturers, has no longer a shadow of foundation. It is now proved that English chemists are as capable as any others; that, in fact, our fault in the past has merely been that we have not given the chemist his opportunity. Yet, although academic and industrial interests have been brought into effective co-operation, with mutual good results, it is none the less clear that the approach made to an appreciation of the value of scientific method in industry and in the public service is by no means so close that the future is assured. "Science" is practically voiceless in the House of Commons; our State Departments still show too little tendency to move with the times and to give heed to expert advice, though there are signs of change even in this particular: a great work is still to be accomplished, therefore, by the schools, to develop a more sympathetic and intelligent attitude in the governing class of the near future.

CONIFEROUS TREES.

Coniferous Trees for Profit and Ornament. Being a Concise Description of each Species and Variety, with the most recently approved Nomenclature, List of Synonyms, and Best Methods of Cultivation. By A. D. Webster. Pp. xx+298. (London: Constable and Co., Ltd., 1918.) Price 21s. net.

CONIFERS are extensively cultivated in this country for the production of timber, for shelter, and for ornament. The number of species employed for these purposes is very great, and their discrimination is often a difficult matter, especially in the young state before they begin to bear cones. Closely related varieties or species may differ widely in value. This is well seen in the Douglas fir, the Pacific coast form of which is perhaps the most valuable conifer that has been introduced, owing to the excellent quality of its timber, of which an enormous volume per acre can be produced in suitable soils and situations in a short period of years. The Rocky Mountain form of this tree, which differs only slightly in appearance, is practically useless in this country.

Few books point out clearly the distinctive characters by which species can be identified, and there is great need for a small, handy volume which will supply concise botanical descriptions with adequate keys, and an accurate account of the natural history and uses of the conifers that can be cultivated in the open air in this country.

The present work, while handy in form, is disappointing on account of its lack of botanical details, there being no clue to the identification of the species, but scattered remarks of an indefinite kind. The descriptive part of about 200 pages is arranged alphabetically, and much attention is paid to varieties and sports which are of minor interest. Some rare species are described at length, of which living specimens are unknown in this country; for example, *Torreya taxifolia, Pinus clausa,* etc., while more important species, of which there are living examples in Kew Gardens, are omitted, as *Larix sibirica* and *L. kurilensis, Pinus armandi* and *P. leucodermis.* It is doubtful if the author has ever examined the beautiful example of Brewer's spruce, near the pagoda at Kew, judging from his remark that "this species has leaves which resemble those of the Norway spruce."

The book concludes with several short chapters, dealing mainly with the cultivation, propagation, uses, variations, and diseases of conifers. For economic planting, Mr. Webster gives notes on the species commonly used for this purpose, but includes the Nootka cypress and the Atlas and Lebanon cedars, which are rarely planted for timber in this country, while he omits the Japanese larch and *Abies grandis,* which are of considerable merit in some situations. Mr. Webster has a high opinion of the Corsican pine for timber production, and instances a plantation of thirty-two years' growth in which this tree has attained 65 ft. in height. The chapter on diseases and attacks by insects, birds, squirrels, etc., is "popular," and has some curious errors of nomenclature. The insect with a woolly covering which lives on the bark of the Weymouth pine is not a species of Coccus, being *Chermes corticalis.* The woolly aphis on the larch is *Chermes laricis,* and not *Bostrichus laricis,* which is the name of a bark beetle. The usefulness of this book for students and practical men is impaired by such errors, which are calculated to throw doubt on the general accuracy of the descriptive matter, which, nevertheless, is readable, and contains much interesting information.

BIOLOGISMS EXPOSED.

From Darwinism to Kaiserism. Being a Review of the Origin, Effects, and Collapse of Germany's Attempt at World-Domination by Methods of Barbarism. By Dr. Robert Munro. Pp. xx+175. (Glasgow: James Maclehose and Sons, 1919.) Price 4s. net.

DR. MUNRO is a whole-hearted selectionist, but a great part of his vigorous book is devoted to exposing the fallacy, not confined to Germany, that might is right, a fallacy which finds its theoretical foundation in a misunderstanding of Darwinism. Natural selection has worked so well, they say, in the evolution of animate Nature that we cannot do better than continue it in the kingdom of man; but, as the author reminds us, it has to be recognised that natural selection has resulted in efficient parasites, as well as in efficient Primates. It is preposterous to assume that the conditions of modern warfare represent a logical continuance of the struggle for existence as observed in wild Nature, for the sifting processes of the terrible four years that the world has wrestled through are in a different category, as Dr. Chalmers Mitchell has well shown, and have worked in great part in the wrong direction—dysgenically, not eugenically. Man cannot, indeed, hope to keep his foothold, still less make progress, without sifting, but Dr. Munro shrewdly lays bare the folly of thinking that man is shut up to Nature's methods. He must assist, improve on, or even counteract them; and civilisation has in great part consisted, as Sir Ray Lankester and others have made clear, in throwing off the yoke of natural selection. More positively, man must substitute rational, social selection for natural selection. Since Huxley's famous essay, many antitheses have been drawn between natural selection and the sifting methods which experience indicates as spelling progress for man, but there has been a tendency to conceive of Nature's tactics too crudely and without Darwin's subtlety. For Darwin quite clearly recognised that endeavours after the well-being of the family are included in the struggle for existence, as well as internecine competition around the platter of subsistence.

Dr. Munro has done a useful piece of work in once again nailing to the counter the false coin of pseudo-Darwinism, and in trenchantly exposing the shallowness of would-be "scientific" biologisms. Man is to make progress not only along the lines of the common ground which he shares with other mammals, but also along the lines of his distinctive peculiarities which make him "a man for a' that." We have not been able to do more than allude to one of the main ideas of an arresting volume, which many will heartily welcome, though they cannot agree with it all. Thus we regret to see the confident statement that "acquired peculiarities during lifetime become sometimes permanent." What proof is there?

OUR BOOKSHELF.

A School Chemistry Method. Being the Teacher's Supplement to Chemistry Notes and Papers. Parts i., ii., and iii. By G. N. Pingriff. Pp. xii+80. (London: "Geographia," Ltd., n.d.) Price 1s. 9d. net.

Chemistry Notes and Papers for School Use. (Notes and Question Papers to Supplement the Pupil's Own Laboratory Notes.) In three parts. By G. N. Pingriff. (London: "Geographia," Ltd., n.d.) Price 2s. 3d. net each.

IN "A School Chemistry Method" an attempt is made to overcome the well-known difficulty of preaching from another man's notes by the issue of a companion booklet explaining the author's method. This part of the work will be found useful, though the first chapter, on "The Aims of Science Teaching," is either not necessary, since the book is intended only for teachers of chemistry, or, alternately, must be considered to be by implication a rather severe indictment of that part of the teaching profession. The remainder of the book explains the manner in which the author intends "Chemistry Notes and Papers" to be used. It must, however, be noted that there are also a detailed syllabus of the course, a list of essay subjects, well graduated and not too difficult, a key to the exercises—both practical and numerical—and a short selection of books suitable for the science library.

The "Chemistry Notes" are made up in twenty-four loose sections, perforated, and fastened together temporarily. The pupil is supposed to make his own text-book from the results of his practical work, and at intervals a section of the notes is to be inserted in this book following some practical work leading up to the subject-matter of the section. The notes are brief, but interesting, and they cover a wide range of topics.

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 Neglect of Biological Subjects in Education.

THE two recent letters in NATURE (January 23 and February 6) under the above title expose a defect in our science teaching which has been plain to me for some years. Hitherto I have refrained from referring to this publicly owing to my lack of authority in educational matters, but I now feel emboldened not only to acknowledge my hearty agreement with the views expressed in these two letters, but also to venture upon a few remarks of a critical nature on a concrete case of science teaching, viz. that of the University of Cambridge. When I took the Natural Sciences Tripos the student had a free choice of subjects (and I fancy the same still holds), selecting usually three or four; none were compulsory. Thus a candidate could graduate in high honours in natural science and yet be totally ignorant of biology. The converse could also occur—for example, by taking zoology, botany, and physiology, the physical sciences could be shirked altogether. The latter course was, perhaps, rarely pursued, but the former, I imagine, must have been commonly followed. It is gratifying to find that at last natural science is to receive a much overdue recognition in the Cambridge Previous Examination, and, though the exact details are not yet to hand, one fervently hopes that both branches, the physico-chemical and the biological, will be included and made obligatory for all students.

It appeared to me in the past that the Cambridge medical student who took the Tripos along with his M.B. examinations received (in theory, at any rate) the broadest education in science that the University had to offer; for in his first M.B. he was obliged to take both physics and chemistry as well as biology. It thus struck me that some such examination should have been made universal for all honours candidates in natural science. Now that science is to be introduced into the "Little-go," the necessity for such an intermediate examination may be less urgent, though one doubts if the need is entirely removed. A further test to ensure a grounding in, not a mere smattering of, all the principal sciences would seem desirable. Then the actual degree examination could have a more restricted range, and at the same time be of a more advanced character than it is presumably at present. Part II. of this Tripos could then be more circumscribed as to its subject-matter, and might with advantage consist partly of a training in research. Surely, for instance, the whole domain of either physics or chemistry is too vast a field for anyone adequately to explore and master with profit for a single examination.

Little change, I surmise, beyond the abolition of that irritating second subject in Part II., has taken place in the Natural Sciences Tripos since the early 'nineties, when I was closely familiar with it. If a radical reconstruction be not feasible, may I plead for a greater selection of subjects for Part II. by the introduction of border-line ones? By way of illustration, let me refer to one of these—biochemistry. Have not the watertight-compartment system and the lack of breadth in the elementary training arising from the option of subjects acted adversely on the output of biochemical research (at any rate, as applied to plants) by the Cambridge school? For instance, the newly fledged botanist who may desire to research in plant physiology from the chemical side is often hampered at the start from his lack of knowledge of, and want of practice in, organic chemistry. The chemist, on the other hand, through being allowed to ignore biology in his training, may not only feel himself unfitted to tackle biochemical problems, but may even be unmoved by them; and yet from his familiarity with organic chemistry he may be quite competent to attack them from this side. The introduction of a subject in Part II. embracing, say, organic chemistry and the physiology of animals or plants (or both, if not too extensive) would tend to produce men thoroughly equipped to undertake biochemical research. Surely here the harvest is great, but the labourers still are few.

JOHN PARKIN.

The Gill, Brayton, Cumberland, February 8.

Arthur Eckley Lechmere and Science at Ruhleben.

THE sad news of the premature death on February 14 of Dr. A. E. Lechmere prompts me to write a few words on what this distinguished and promising biologist was to us at Ruhleben. It was the writer's privilege to collaborate with Dr. Lechmere and others in the building up of that little oasis in Ruhleben, the natural science laboratories.

Unique as an institution—science laboratories in an internment camp—unique also in their aboriginal primitiveness—the hay-loft, and later the horse-boxes, of the oldest and most ramshackle stable in the camp—they became in course of time quite well equipped, and the scene, not only of steady and systematic teaching and study, but even of research.

The history of the science laboratories at Ruhleben is the history of a development in the face of powerful internal and external opposition, and may be said to have reached its climax on the occasion of the Natural Sciences Exhibition in September, 1918, when the laboratories of Ruhleben were thrown open to the "general public" of the camp and proved themselves the greatest popular attraction that the camp had experienced, receiving in due course the patronage also of the commanding officer and his staff.

Of all those who worked assiduously for the cause of science in Ruhleben, Dr. Lechmere was alike the most distinguished and the most enthusiastic. A keen worker and a true lover of science, he was at the same time a man of extraordinary versatility. He was qualified as an electrical engineer, and at Ruhleben, besides inaugurating and leading the biological department, he devoted considerable time and thought to artistic bookbinding and to the designing and finishing of dresses and decorations for the Ruhleben stage.

During his four years at Ruhleben Dr. Lechmere gave numerous popular lectures to large audiences on biological subjects of general interest, such as evolution, parasitic diseases, inoculation (at the time of the smallpox scare), "Some Monkeys and Man," etc., generally illustrated with lantern-slides, most of which were made by himself at Ruhleben. In the biology laboratory itself he was always at work, and found in the small pond situated in the middle of the playing-field a plentiful reservoir for, in particular, microzoological study.

The writer speaks as a layman on the subject of biology, but he can safely assert that the biology laboratory, with its first-class microtome, its stock of fine microscopes, its excellent electrically regulated thermostats, was an achievement that the camp could be proud of, and Dr. Lechmere himself loved the place and practically lived in it.

As the laboratory accommodation and the facilities grew, the contact between the various branches of natural science became more close, geology, chemistry, and physics all having a large number of students. Thus laboratory work could be found in all branches for students of natural science, and we may say that nothing could have been more harmonious than the co-operation of all the science departments of Ruhleben Camp School.

Space here does not admit of a description of the exhibition; may it suffice to say that one could occupy several hours profitably in passing through and observing the various exhibits and the experiments being carried out; it was noted that its effect was to stimulate energetically the interest of the general public in natural science.

To this achievement of the sciences in Ruhleben Dr. Lechmere contributed the largest share, and contributed it with that extraordinary grace and with that infinite kindness which were his. He was often in bad health. The severe winters in almost unheated barracks told on him. But he stuck to his task under the most trying conditions. To his colleagues and friends at Ruhleben, to the students who profited by his wonderful teaching and lecturing, many of whom are now pursuing their studies at our universities—to all these his untimely death, coming so soon after his return to England, is deeply tragic.

J. W. B.

SEA AGGRESSION.[1]

THE appearance of a second edition of Prof. Matthews's book on "Coast Erosion and Protection" is testimony to the value of the publication, and, at the same time, to the concern which has been aroused of late years over the continued inroads of the sea on the shores of this country, and the much debated responsibility of the State for the preservation of its coastline. The erosion of the littoral, and particularly that part which fringes the eastern and southern counties of Great Britain, has been an evident process for centuries, but it is only recently that its cumulative effects have become realised, to such an extent, indeed, as to excite a feeling of consternation on the part of those whose property is threatened with obliteration. In 1906 a Royal Commission was appointed to investigate the situation and to advise as to the best means of preventing further depredations. Its recommendations were embodied in a final report issued in 1911. To put the matter briefly, it repudiated the contention of national liability, but approved the establishment of a central authority for the care and administration of the coastline, and suggested the conferment of powers upon the Board of Trade to prevent the unauthorised depletion of shingle beaches.

Photo] [Spurr, Bridlington

[FIG. 1.—General view of Holderness Coast, showing erosion. From "Coast Erosion and Protection."

As engineer to the Municipality of Bridlington, on the Holderness coast of Yorkshire, where erosion has been perhaps more marked than in any other part of the British Isles (between Flamborough Head and Spurn Head there is a recession of 7 miles, of which 3½ miles have probably been wasted since the date of the Roman invasion), Prof. Matthews had unique opportunities of studying the subject, particularly as it fell to his lot to carry out protective works to secure the township from further encroachments. The measures which he adopted, and the designs which he prepared and executed for the walls on the sea-front, are fully described, and the details will be extremely valuable for reference by those who have similar problems to face. The volume, however, is more than a merely local survey; useful particulars are given of work carried out at other coast towns — Hartlepool, Folkestone, and Hastings, for instance — and there is some description of protection works on the coast of Holland. Groynes are illustrated, as well as sea-walls, and there is an interesting investigation, with a description of experiments carried out by the author on small-scale models, into the effect of projections in the coastline on the travel of sand and shingle.

The book is profusely illustrated; in less than 200 pages of printed matter there are as many as 100 figures, including thirty photographic plates. Some very effective snapshots of storm waves are included among them, of which Fig. 2 is an example. It enables some idea to be formed of the tremendous force of wave impact; sufficient to try the stability of carefully constructed walls of solid masonry, the effect on unprotected cliffs of chalk and clay can readily be imagined.

FIG. 2.—Storm wave at Hastings, October 1, 1911. From "Coast Erosion and Protection."

The arrangement of the book, embodying as it does a series of articles contributed at different

[1] "Coast Erosion and Protection." By Prof. Ernest R. Matthews. Second edition, enlarged. Pp. xvi+195. (London: Charles Griffin and Co., Ltd., 1918.) Price 12s. 6d. net.

times to engineering journals and to the proceedings of technical societies, is possibly susceptible of some slight improvement in co-ordination, which will no doubt receive consideration in future editions, and so bring it up to the admirable standard of the subject-matter.

A chapter is devoted to a consideration of the action of sea-water on cement, in which the author details the results of certain experiments which he carried out. The conclusion which he arrives at in regard to the use of salt water for mixing is scarcely one which will be endorsed by all engineers who have had experience in maritime works. When concrete is deposited, as is often the case, beneath the surface of the sea, in a viscous condition, it is a matter of indifference whether it has been mixed with fresh water or with salt—the salinity of its environment is bound to permeate it before it has time to set. This consideration applies equally to mass work deposited at low water in tidal situations.

BRYSSON CUNNINGHAM.

SOME DEVELOPMENTS IN BRITISH INDUSTRY DURING THE WAR.

IT is, of course, too soon to attempt to gauge the full effect of the great war upon the development of the world's industries, or to seek to determine how it will ultimately affect the relative position of the belligerent nations as trading communities or their respective influence upon international commerce. But there can scarcely be a doubt that with the defeat of the Central Powers, and the consequent upheaval in their social and political status, the centre of gravity, as it were, of the whole system of the world's trade has been profoundly, and, indeed, fundamentally, changed. During the last four or five decades Germany had achieved an astonishing expansion in industrial progress. In certain branches of manufacture, especially in those directly dependent upon the application of science, she was rapidly becoming supreme among the nations, and could, in many cases, impose her own terms upon those who desired to purchase her products.

The war has served to bring home to us, as nothing else could have done, the ramifications of the subtle and insidious conspiracy by which her Government and her leaders of finance, commerce, and industry sought to make that supremacy comprehensive and complete, assured and unassailable. As regards the technical applications of science, blinded by her unquestioned successes in assimilating and turning to practical account the discoveries of more creative nations, she had lulled herself into the belief that she had nothing to fear from any of her trade competitors, certainly not from this country, from whom she had appropriated and steadily exploited certain "key" industries. Furthermore, she had persistently, by methods fair and foul, sought through the course of years to obtain control of the principal sources of important raw materials, especially of such as are essential in modern warfare or necessary for the welfare of her people in such a war as she contemplated. She had studiously contrived also that this control should work to the disadvantage of this country in case we should be drawn into the struggle. This latter fact might be illustrated by a hundred examples culled practically from every oversea Dominion. It was only on the outbreak of war, and on our inevitable participation in it, that the meaning and true intention of this crafty and treacherous combination were fully realised.

When, therefore, we were driven to draw the sword in compliance with our treaty obligations, we were suddenly face to face with the peril in which we stood from a too trustful confidence in the integrity of a nation the highest ethical and political ideals of which are now seen to have been based upon the precepts and practices of a dynasty which, in raising it to power with a ruthless disregard of every moral consideration, at length overreached itself, and involved itself in ruin and its people in disaster. How we grappled with this peril and overcame it has been the wonder and admiration of the civilised world, and will ever remain one of the proudest episodes in our national history. Nothing in our existence more strikingly exemplifies the innate qualities and genius of our race. For years past it was the confident belief of the intellectuals of Germany that we were a decadent people, that we had lost our old-time virility and were enervated by wealth and material success. To those who only superficially knew us, and were, moreover, biassed by a predisposition to exalt themselves and to regard more the motes in other people's eyes than the beam in their own, there might appear some ground for this belief. We were too much concerned in minding our own business and in seeking to solve our own social problems to pay the heed that the sequel showed we ought to have done to the Machiavellism of our cunning and deceitful foe. But the shock of war brought a rude awakening, at first to us, and ultimately to our enemies. We, like them, have been tried as in a furnace, and we at least have come triumphantly through the ordeal, welded, strengthened, and ennobled, with purer ideals and a larger and richer conception of our place and destiny in the world. The beaten and disillusioned foe will, we may hope, be no less bettered by the fiery trial; bruised with adversity, her pride fallen with her fortune, and her "swashing and martial outside" a hateful memory, let us trust that she will throw down her false gods. In that case, what we learned to know and to respect in the Germany of old will not be wholly destroyed; we may hope it is too ingrained in the national character not to reassert itself, and that it will bring her once more within the comity of nations.

The true story of this most momentous episode will tax the insight and imagination of successive historians for centuries to come, for the world has never witnessed the like of it, and will, we trust, never see its repetition. Civilisation has at length risen, as never before, to the conception that such a method of settling national aspirations or international disputes is an affront to the common sense of humanity, and that it ought not to pass the wit of man to devise some more rational means of composing them. What the method is to be is the great problem, for a solution of which the whole world waits with anxious expectation.

In analysing the conditions and circumstances which have determined the issue of this great struggle the historian must necessarily have regard to the genius, mentality, and characteristic attributes of the contending nations, for, in the long run, they are the main factors which tell for success. In this age of printing and of meticulous care in the preservation of public documents he will not be gravelled for lack of matter. We have already almost countless memorials and *mémoires pour servir*. Among them we may cite a stimulating paper by Mr. F. G. Kellaway, M.P., on "Some Developments in Industry during the War," addressed to the Industrial and Reconstruction Council, and published in an abridged form in NATURE of January 30. Even on its own subjects it is by no means exhaustive. But *ex pede Herculem*. We may judge of the whole from the specimens. And Mr. Kellaway's specimens are admirably typical and illustrative of the point which we desire to enforce: that it was to the inborn qualities of our race, its courage and tenacity of purpose, its resourcefulness and power of initiation, its inventiveness, adaptability, and steady determination to "win through," in spite of every obstacle, setback, or difficulty, that brought us victory in the end and crushed the greatest crime against humanity the world has ever known.

The war, in the Prime Minister's phrase, quoted by Mr. Kellaway, has been as "a star-shell illuminating the dark places in our national life." It has "revealed with pitiless accuracy the defects in our industrial equipment." It is the purpose of the paper to show how, as the result of the war, many of these defects have been overcome, and that the United Kingdom, as a consequence, is now first in the world in almost every sphere of industrial effort. As we have already reproduced the main part of Mr. Kellaway's interesting paper, it is unnecessary to go into any great detail now concerning its contents. Its author shows how we have incidentally wrested from Germany her predominant position in electrical industry, and once more secured the control within our own Dominions of such vital materials as mica, tungsten, and chromium (for the manufacture of high-speed steel, armour-piercing shells, the wearing parts of aeroplane engines and gears in motor vehicles, stainless cutlery, and rustless steel). Tungsten and chromium were among the non-ferrous metals of which Germany had managed to capture the main sources of supply. We are told that before the war the British Empire produced 40 per cent. of the wolfram ore, but so successfully had Germany secured the trade that no British manufacturer had been able to establish the industry in this country. "At the outbreak of war one of the two firms endeavouring to manufacture in this country was only able to keep going with difficulty, and the other only succeeded in keeping its works going by entering into a contract to supply the whole of its output to Messrs. Krupp, of Essen." We have changed all that. British manufacturers are now in a position to deal with all the ore produced within the British Empire, and could, if necessary, convert the whole world's output into tungsten metal or ferro-tungsten. A similar result may—and, if we are wise, certainly will—follow in the case of zinc, which occupies the third place in importance among the non-ferrous metals, and of which Germany, owing largely to the control she had secured over the Australian concentrates, was the largest European producer, 77 per cent. of that which we needed being imported by us from her. Australia will no longer supply Germany with her zinc ore, and the British Empire bids fair to share with America the bulk of the zinc production of the world.

Even if space had permitted, it is unnecessary, for the reason already given, to dwell in any detail upon the other instances which Mr. Kellaway adduces of England's "wakening up" and of the rousing of her energies as the consequence of the call to arms. Official control, co-operation, and combination of effort unquestionably accelerated and facilitated the introduction of improvements in organisation, management, and practice, and have exerted a permanent influence upon industries which have been pressed into the service of war. It is seen in its effect upon the manufacture of machine-tools; in a vast improvement in machinery; in increased accuracy of work as a result of the necessity for organising the production of interchangeable repetition work; in improved methods of shop transport; and in a wider appreciation of the value of scientific knowledge in machine construction.

In no department is this more marked than in aircraft work. The experience of the war has effected nothing less than a revolution in this industry. A single instance must suffice. As Mr. Kellaway states, modern warfare, no less than much of modern transport, and, indeed, of modern industry in general, is dependent upon the magneto. "In the air it is an essential source of power and movement." Our position in 1914 with regard to the production of magnetos was exceedingly grave. Practically everything needed to make them in sufficient quantity was not procurable in the British Isles, and it required months —nay, years—of effort to surmount our difficulties. But they have been surmounted. "Instead of one firm producing only 1140 magnetos in a year, as was the case in 1914, we now have some fourteen firms producing 128,637 magnetos in a year. . . . It is not only that we are producing in quantity which makes us independent of outside sources; the quality of the British magneto is the highest in the world. It is lighter in weight and more reliable in service than the Bosch magnetos manufactured before the war, or than the latest examples found in captured German aeroplanes."

"It is thus not only on the field," adds Mr. Kellaway, "that we have beaten the Bosch." What is true of the magneto is equally true of the ignition-plug. In 1914 three firms were producing a yearly output of not more than 5000 plugs. By October 31, 1918, the yearly output of five firms had risen to 2,148,725, and they were being supplied, not only to our own Services, but also to our French, Italian, and American Allies.

The story of the influence of the war upon our glass industry, and especially upon the manufacture of scientific and optical glassware, is no less inspiriting. Germany has once more been beaten at Jena. But it will scarcely be credited that at the outbreak of war a considerable part of our artillery was equipped with gun-sights exclusively "made in Germany"—the dial sight No. 7 of Goerz. There is much that needs clearing up concerning the pre-war methods of the War Office, and surely this is a case in point. That we should have become dependent upon a potential enemy for so essential a piece of mechanism as a gun-sight is surely one of the most astonishing instances of departmental ineptitude that could be conceived. But it is reassuring to be told that the resourcefulness of our opticians has been equal to the nation's emergency. The British sight is described as "a beautiful and delicate piece of work, and its production in such numbers, and in a perfection which Germany never exceeded, is a triumph for British skill."

NOTES.

THE achievement in wireless telephony recorded in the daily Press during the past few days is by no means unique. It is reported that Mr. Daniels, Secretary of the U.S. Navy, successfully telephoned a wireless greeting to President Wilson on board the *George Washington* when the vessel was more than eight hundred miles out at sea. According to a paper presented before the American Institute of Electrical Engineers, wireless and wire telephone systems can be linked so that the human voice will perform one lap of its journey over wire and the next lap through the ether to its final destination, while the replying waves will travel the air waves first and then proceed on wire. The operation of transferring sound from wire to air can be accomplished by a device similar to the repeater now used in long-distance telephony. Latest developments in connection with the wireless telephone would suggest the latter as an excellent supplement of wire systems. As a rival, however, it has not yet reached the stage when its claims can be considered seriously, partly because of the lack of secrecy involved in its use.

PROCLAMATION is made that the unlicensed importation into the United Kingdom is prohibited of the following articles:—All derivatives of coal-tar generally known as intermediate products capable of being used or adapted for use as dyestuffs, or of being modified or further manufactured into dyestuffs. All direct cotton colours, all union colours, all acid wool colours, all chrome and mordant colours, all alizarine colours, all basic colours, all sulphide colours, all vat colours (including synthetic indigo), all oil, spirit, and wax colours, all lake colours, and any other synthetic colours, dyes, stains, colour acids, colour bases, colour lakes, leuco-acids, leuco-bases, whether in paste, powder, solution, or any other form.

THE municipality of Le Havre, by a resolution of September 11, 1918, established the Institut Océanographique du Havre and appropriated funds for its maintenance. This places on a secure and public foundation the institute and laboratory of the University of Caen at Le Havre, and it will be conducted by the same staff, to the efforts of which during the past few years this last success is due, namely, the director, Dr. A. Loir, medical officer of health; the head of the laboratory, Mr. H. Legangneux; and the superintendent of biological research, Mr. E. Peau. Daily observations on the temperature and condition of the water, and on its bacterial, planktonic, and general biotic content, will be recorded at three fixed points, with the co-operation of naval officers. Other observations will continually be made at the French and British naval stations in the port, by permission of the respective commanding officers. Results of scientific and practical importance have already been obtained, and will now increase in number and extent.

MR. R. C. J. SWINHOE, of Mandalay, has presented to the Geological Department of the British Museum a collection of red amber from Burma, sometimes known as burmite, which contains the remains of a remarkably interesting insect fauna. The material has been examined by Prof. T. D. A. Cockerell, who has published in *Psyche* and in the Annals of the Entomological Society of America the descriptions of thirty-one new species, five of which are types of new genera. Most of these were contained in a block of amber rather larger than a man's fist; this has been cut into slices about half an inch thick, and every one of them is crowded with insect remains. There are representatives of Hymenoptera, Hemiptera, Homoptera, Diptera, Trichoptera, Coleoptera, Termites, Acarina, and Diplopoda—in fact, ants are about the only kind of insect the absence of which is conspicuous. The amber occurs in clay beds of Miocene age, but it was washed into them from higher levels, and may be much older. This is certainly the most important addition made of recent years to the very large collection of insects in amber already preserved in the department. It is unfortunate that the deep colour of the amber renders it very difficult to exhibit the specimens so that their contents can be seen by the public.

IN many cities of the United States there are historical societies which have organised museums illustrating the history of the State or locality, but there is no central museum of national history. So, too, there are many museums of art, well known for their treasures and their enterprise, but such collections as pertain to the National Gallery of Art are provisionally housed in one of the halls of the Natural History Museum. It is, therefore, good news that on January 29 a Bill was introduced by Congressman Hicks in the House of Representatives to provide for a national museum of history and the arts, and it was a happy thought of his to propose such an institution as a memorial to Theodore Roosevelt. The idea is one that would have commended itself to that wide-reaching, enthusiastic, and patriotic spirit, for it is intended to assemble and display, not merely relics illustrating the personal and political history of the United States, but also such objects as will elucidate all the cultural development of the nation. Thus the museum will comprise, in addition to the collections of fine art and the national portraits, exhibits elucidating the evolution of all the arts and crafts and their application to all branches of human activity. The same applies to the application of science to the industries and the exploitation of the natural resources of the country—a subject in which Mr. Roosevelt took a profound and practical interest. It is proposed that the building shall be erected in Washington. We wish the scheme all success.

SUMMER time will be brought into force this year on the morning of Sunday, March 30, and will continue until the night of Sunday-Monday, September 28–29.

WE announce with much regret the death on February 19, at eighty-five years of age, of Dr. F. Du Cane Godman, F.R.S., trustee of the British Museum, and distinguished for his work in natural history, especially ornithology.

WE notice with regret the announcement of the death, in his fifty-seventh year, of Lt.-Col. A. M. Paterson, professor of anatomy in the University of Liverpool since 1894, and ex-president of the Anatomical Society of Great Britain and Ireland.

THE Linen Industry Research Association of Belfast is about to appoint a director of research at a salary of not less than 1000*l*. per year. The selected candidate will be expected to make a survey of the entire field of research in the linen industry, to draft a programme of research, and to organise and supervise the carrying out of the scheme.

DR. T. A. HENRY, superintendent of the laboratories at the Imperial Institute, London, has been appointed director of the Wellcome Chemical Research Laboratories, London. Dr. F. L. Pyman, the former director of these laboratories, has accepted the professorship of technological chemistry in the College of Technology, University of Manchester.

IT is intended to hold a discussion on "Metrology in the Industries" at the meeting of the Physical Society on Friday, March 28, at the Imperial College of Science, South Kensington. Sir R. T. Glazebrook, Director of the National Physical Laboratory, has promised to introduce the discussion, and it is expected that several of the leading authorities on fine measurements will take part.

THE fifth lecture of the series arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, March 5. The chair will be taken at 4.30 by Sir George Riddell, Bart., and a lecture entitled "Industrial Changes Caused by the War" will be delivered by Prof. A. W. Kirkaldy, University of Birmingham. Applications for tickets should be made to the Secretary, Industrial Reconstruction Council, 2 and 4 Tudor Street, E.C.4.

NEXT Tuesday, March 4, Prof. H. Maxwell Lefroy will deliver a lecture at the Royal Institution on how silk is grown and made—mulberry silk, and on March 11 on insect problems. The Friday evening discourse on March 7 will be delivered by Prof. H. C. H. Carpenter on the hardening of steel; on March 14, Prof. A. Keith on the organ of hearing from a new point of view. On Saturday, March 8, Sir J. J. Thomson will give the first of a course of six lectures on spectrum analysis and its application to atomic structure. Prof. Hele-Shaw's lectures on "Clutches," announced for March 4 and 11, are unavoidably postponed until after Easter.

WE regret to record the death of Mr. Henry Bell Wortley on February 17. An account of his career appears in the *Engineer* for February 21. Mr. Wortley was a member of the firm of steamship owners, Alfred Holt and Co., of Liverpool, and was fifty-one years of age at his death. He was trained as a naval architect with various firms on the Tyne, and after joining the Liverpool firm he was responsible for new features in the design of many ships belonging to the Holt Co. Mr. Wortley was a member of the Institution of Civil Engineers and the Institution of Naval Architects. During the war he took an active part in placing Liverpool in the forefront as a munition-producing area.

THE next ordinary scientific meeting of the Chemical Society will be held at Burlington House on Thursday, March 6, at 8 p.m., when Prof. J. W. Nicholson will deliver a lecture entitled "Emission Spectra and Atomic Structure." It was announced at the meeting held on February 20 that the following changes in the list of officers and council had been proposed by the council:—*President:* Sir James J. Dobbie. New *Vice-Presidents:* Dr. H. J. H. Fenton and Prof. James Walker. New *Ordinary Members of Council:* Mr. J. A. Gardner, Prof. F. E. Francis, Dr. C. A. Keane, and Sir Robert Robertson. The anniversary dinner of the society will be held in the Connaught Rooms, Great Queen Street, W.C.2, on Thursday, March 27, at 6.45 for 7 o'clock.

WE extract from the *Lancet* the following obituary notice of Prof. R. Blanchard, who died on February 8 at sixty-one years of age. Prof. Blanchard had occupied for long the chair of parasitology at the faculty of medicine in Paris, and his great reputation in France and abroad was due to his works on medical zoology, and particularly to his researches on the animal carriers of pathogenic germs and their *rôle* in the propagation of epidemics. The "Traité de Zoologie Médicale," in two volumes, first appeared in 1886–90. At the time of his death he was engaged on the great task of a history of medicine, and had made some progress in the publication of a *corpus inscriptionum* devoted to medicine and biology. His diligence was incredible. Prof. Blanchard was secretary to the Academy of Medicine, and he founded the French Society for the History of Medicine, the Colonial Institute of Medicine, and the French Congress of Zoology. For twenty years he acted as general secretary to the Zoological Society of France. Owing to the part which he took at several of the International Congresses of Medicine he became a well-known figure abroad.

MATHEMATICIANS and astronomers will learn with much regret that news has been received through a correspondent in Stockholm announcing the death of Alexander Michailovitch Liapounoff. He is said to have died at Odessa by his own hand as a result of the Bolshevist *régime*, but we have no means of confirming the report. Liapounoff held the chair of applied mathematics in the Petrograd Academy. His more important papers were published mainly in the Memoirs of the Academy and in Liouville's Journal. Unfortunately for English readers, a number were written in Russian, only summaries and abstracts appearing in French. His earlier work lay in the direction of broad, general theorems in hydrodynamics and the theory of gravitating masses. His later, and perhaps best-known, work dealt with the stability of the pear-shaped figure of a rotating mass of liquid, a problem of the first importance to theories of cosmogony. Poincaré had developed a method for the analytical discussion of the problem in 1901, but did not carry out the necessary calculations in detail, and so reached no definite conclusion. In 1902 Sir G. Darwin announced that he had proved the pear-shaped figure to be stable, but this announcement was followed by a paper from Liapounoff in 1905, in which it was claimed that the pear-shaped figure was unstable. Liapounoff's work was distinguished by the combination of clear physical insight and masterly analytical skill.

INFLUENZA has again further increased in severity over the British Isles, and the Registrar-General's return for the week ending February 15 shows the deaths in London (County) to be 273 due to the epidemic. Forty-eight per cent. of the deaths occurred at the ages from twenty to forty-five, so that the death incidence is similar to that when the present epidemic was most virulent at the commencement of last November, the complaint attacking most severely the strong and able-bodied. Influenza caused 13 per cent. of the total deaths during the week ending February 15, pneumonia 13 per cent., and bronchitis 16 per cent.; in the early part of November influenza caused 57 per cent. of the deaths from all causes, but deaths from pneumonia and bronchitis were not very different from those at present. In the ninety-six great towns of England and Wales, including London, there were 1363 deaths during the week from influenza, and since the commencement of the epidemic in October last there have been 48,736 deaths, whilst in London there have been 12,286 deaths. The total deaths in any previous epidemic in London have only amounted to about 2000. The present is the twentieth week of the epidemic, five of the previous epidemics having continued as long, and the epidemic from October 1904 to April 1905 continued for twenty-six weeks, but in London during the whole time the total deaths from influenza were only 707, and the maximum number in any week was only forty-five.

AN interesting note is contributed to the German weekly scientific paper, *Die Umschau*, for November 30, 1918, by the editor, Prof. J. H. Bechhold. Prof. Bechhold indicates the manner in which German science can aid the Fatherland in its hour of defeat and assist it to gain the supremacy in the economic sphere. After pointing out that reconstructed Germany must perforce be simple in order to conform to the new conditions of life imposed upon her by recent events, he asks the question: In what relation shall science, technics, and art stand in the new State? Germany, it is explained, must in future seek to live upon her own resources; further, she will have only a small amount of raw material surplus to her own needs, and for this reason it will be incumbent upon her to export the output of her genius; to meet the situation as it should be met, Germany will have to build herself up on efficiency management. She is told that she must attempt to excel all other countries in the quality of her precision instruments and lenses, artificial silks and textiles, dyes and medicines, high-class furniture and works of art, in order to create a demand for these valuable products of her industry in foreign lands. For this reason, Germany will require, says Prof. Bechhold, highly trained engineers, chemists, electricians, skilled mechanics and artificers, and, in order that her needs in these directions may be suitably met, she will further require first-class teachers, first-class training institutions and research laboratories, as well as colleges. These matters are, it is stated, of such overwhelming importance that they must not be permitted to become a class or caste question; there is little danger of this at the present time, for already the intellectual men in Germany are combining forces in various directions: this is so in the case of the technical man and the academician, as well as in that of the artificer and the university professor. Finally, an inventors' institute must be founded in order that the inventor may be furnished with advice, the commercial possibilities of his work tested, a selection made of what is best, and a good market found for that which is of real worth. Prof. Bechhold evidently intends that German science shall make a mighty effort in order that Germany in defeat may prove herself as formidable in the economic sphere in the future as ever she was before her great downfall.

MR. ARTHUR L. LEACH has published an account of the prehistoric remains in the museum at Tenby. An interesting series of adinole and flint implements was acquired from the Hoyle Cave. Mr. Leach maintains that the relics found in the caves on Caldey Island prove that it was connected with the mainland when the mammoth, rhinoceros, and reindeer were the characteristic fauna of this region, a connection which lasted until Neolithic times. The collection includes many later remains of the Bronze and Romano-British periods. A little rock-shelter, Nanna's Cave, in the Isle of Caldey, the earliest inhabited site which can be approximately dated, was occupied between about 250 and 400 A.D.

THE measures for the reformation of the numerous wandering criminal tribes which pervade northern India, and are a serious menace to the cultivating classes, have long engaged the attention of the Government. A fairly satisfactory report of the establishment of a reformatory settlement at Amritsar, in the Punjab, has recently been published. The mortality among these people, accustomed to eat carrion and food cooked in an unwholesome way, has been excessive. On their arrival at Amritsar much dismay was caused among them by the discovery that a gallows still stood in one of the jail yards. But they soon became reconciled to their new environment, and many of the younger members have shown an unexpected aptitude for industrial work in the woollen mills. The only remedy is to intern these pests of Indian society, and the experience of the Amritsar settlement shows that, under judicious, kindly officials, the younger members at least of the gangs may be trained to abandon their criminal nomadic life, and accustom themselves to industry.

MR. T. A. JOYCE describes in the January issue of *Man* a remarkable wooden stool recently acquired by the British Museum from the island of Eleuthera, Bahamas. Objects of wood from the West Indies are by no means common, and specimens from the Bahamas are exceedingly rare. From one of the shorter sides of the seat of this chair projects a knob, which has been carved to represent a grotesque human head, of which the eyes and mouth have evidently at some time been emphasised by inlay, probably of shell. These State chairs were used for a honorific purpose, for chiefs and other distinguished persons. A compliment of this kind was paid to a party sent by Columbus to visit a Cuban prince. The Museum already possesses examples of wooden objects of Taiman workmanship of very great importance, including a stool from Cuba of very unusual type. The new specimen is an interesting and important addition to the collection.

IN the course of some "Notes on Birds Observed near Dunkerque," published in *British Birds* for February, Mr. H. F. Witherby makes some extremely interesting observations on the nesting habits of the Kentish and little ringed plovers. The former species, he remarks, has a habit of embedding its eggs in the sand whenever they have to be left unguarded, no more than the broad end being exposed to view. During incubation they are brought to the surface again. The actual hatching time for the eggs of the little ringed plover—that is to say, the time taken from the "chipping" of the shell to the complete emergence of the chick—is not, apparently, less than forty-eight hours. The downy nestlings of these two species are readily distinguished by their markings, yet, when the chick of one species is substituted for that of the other, the parents do not seem to realise that such an exchange has been made.

Proposals are on foot to develop and utilise the water-power resources of Iceland. In an article on the subject in *La Géographie* (vol. xxxii., No. 3) M. Rabot points out that the waterfalls of the island could provide at least 4,000,000 h.p. An Icelandic-Norwegian company proposes to harness the Thorsa, the longest river in Iceland, on which there are at least six splendid falls available for industrial purposes. The Thorsa could provide 800,000 h.p. for five months of the year, and not less than 1,100,000 h.p. for the rest of the year; the largest fall could furnish 500,000 h.p. for seven months. It is proposed to use this power in the manufacture of nitrates and sulphates of ammonia. A further project is attracting the attention of the Danish East Asiatic Co. It proposes to carry wheat from Port Nelson, on Hudson Bay, to Iceland, and there to utilise the power of the Thorsa River in milling it preparatory to export to Europe. Despite the abundance of water-power, Iceland presents certain disadvantages in its development as an industrial country. The frequency of earthquakes, not to mention eruptions of lava, may interfere with mechanical installations. Glacial floods, which are frequent and violent, may also cause difficulties. Lastly, the labour question will have to be solved, for Iceland has not sufficient labour to meet the demands of industrial development.

Meteorological Office Circulars Nos. 31 and 32, to February 1, issued monthly, show that a climatological station has been established at Keswick, and observations will be used for the Monthly Weather Report from January. A climatological station has also been established at Strathpeffer, Ross-shire, so that, after a break of about eighteen months, this northern spa is again represented in the Monthly Weather Report. There is the gratifying information of a Rainfall Association for Munster. Much need for additional rain information for Ireland has been felt, especially with the prospect of forestry and water-power. There is promise of "the analysis of wind records at Southport"; this discussion by Mr. J. Baxendell uses twenty years' observations. Advance copies of a "Manual of Meteorology," part iv., are available for official use. It gives "The Relation of the Wind to the Distribution of Barometric Pressure," by Sir Napier Shaw. It is stated that "it represents the progress made chiefly by those who have been associated in the work of the Meteorological Office in the past twenty years." Circular No. 32 contains a scale of surface visibility as adopted by the Meteorological Office, the Admiralty Meteorological Service, Meteorological Service Royal Air Force, and the French Army Meteorological Service. The scale 0 to 8 is given in metres and in miles at which objects are not visible in good daylight, 0 not beyond 200 metres, and 8 not beyond 30,000 metres or 18·6 miles.

In the *Revue générale des Sciences* for January 15, Prof. F. M. Jaeger, of the University of Groningen, gives a *résumé* of the results which have been obtained in his laboratory during the last five years on the chemico-physical properties of substances at high temperatures. The surface tensions of organic liquids have been determined up to about 200° C., and of fused salts up to 1600° C., by the submerged bubble method. While the surface tensions of organic liquids diminish rapidly with increase of temperature, those of fused salts change very little. The electrical conductivities of the fused salts have also been determined up to 1600° C. in some cases. All the salts investigated have conductivities which increase with temperature according to a linear law.

A series of articles has appeared dealing with the radiation-characteristics of the incandescent mantle, being chiefly an extension of the work of Rubens on the thoria-ceria mixtures to a large family of such combinations. It exhibits the Welsbach mantle (Journal of the Franklin Institute, November, 1918) simply as one of a group of possible combinations of radiating materials. The closest study has been made of the behaviour under various conditions of the absorption bands to which the enhanced visible radiation of the more efficient mantles is due. No explanation has been found for the occurrence of the visible absorption bands of ceria and other materials, but the information obtained as to the conditions under which they appear and disappear has made possible a fairly complete explanation of the different behaviour of the mantle in flame and cathode-discharge heating.

In two papers published in the Proceedings of the Tokyo Mathematico-Physical Society (ser. 2, vol. ix., October, 1918) Mr. Keiichi Aichi makes an interesting contribution to the hydrodynamical theory of density or temperature seiches. By developing Love and Rayleigh's treatment of oscillations in a fluid of variable density, he arrives at an expression for the period of internal seiches in a basin of uniform depth with vertical sides, in which two layers of uniform, but different, density are separated by a transition layer in which the density varies exponentially. Lakes of rectangular or circular shape alone are considered. The interest of such a discussion is mathematical rather than physical, as the theory takes no account of shelving shores or irregularity of shape. Therefore, for comparison of observed with computed periods it is as satisfactory to assume the simple case of a sharp discontinuity of density with uniform density above and below the boundary. Chrystal's treatment of the problem, as developed by Dr. E. M. Wedderburn, though less rigid mathematically, affords a safer method of comparison, as all the peculiarities of the shape of the lake basin are taken into account, and it is unnecessary to assume any arbitrary law for the variation of density. Taking the case of Loch Earn in August, 1911 and 1913, temperature seiches with periods of 15·2 hours and 19·5 hours respectively were observed. The corresponding periods computed by Dr. Wedderburn were 15·0 and 19·6 hours. Mr. Aichi, using the same data and employing his method of calculation, obtains periods of 17 and 16 hours. The papers conclude with some remarks on the possibility of internal seiches in the ocean, and it is shown that in a tropical sea, 3 km. deep and 1000 km. long, internal seiches with periods of from 3 to 4 days may be expected.

An illustrated article in *Engineering* for January 31 gives particulars of the double-reduction geared turbines made by the Parsons Marine Steam Turbine Co., Wallsend-on-Tyne, for single-screw standard vessels. There is one high-pressure and one low-pressure turbine working in series. The high-pressure turbine is of the impulse type, and coupled by means of flexible couplings and pinion to the starboard first reduction wheel. The low-pressure turbine is of the reaction type, and coupled in a similar manner to the port first reduction wheel. The first reduction wheels are mounted on pinion shafts working into the second reduction wheel, which is connected direct to the thrust shaft with a thrust block of the pivoted type. The total shaft horse-power of the installation is 2900; the speed of the propeller is 78 revolutions per minute, and each turbine has a speed of 3500 revolutions per minute. The gearing is arranged to give the following ratios:—From turbines to first reduction wheel, 7·9 to 1; from first reduction gearing to second reduction wheel, 5·7 to 1; and the total reduction ratio is 45 to 1. The wheels and pinions are of the usual double-helical type; the first reduction wheels are made of cast-iron with wrought-steel tyres shrunk on; the second reduction wheels are of cast-iron with cast-steel tyres shrunk on; all four pinions are of nickel steel. The axial pitches of the teeth in the first and second reduction gearing are 7/12 in. and 1 in. respectively; the angle of helix is 30°.

THE January, 1919, issue of the quarterly classified list of second-hand instruments for sale or hire published by Mr. C. Baker, 244 High Holborn, W.C.1, has been received. Several new pieces of apparatus, which Mr. Baker can still supply, are included in the list and are suitably distinguished. Readers who may require microscopes, surveying instruments, telescopes, spectroscopic apparatus, or physical apparatus of a general kind should examine this comprehensive catalogue.

OUR ASTRONOMICAL COLUMN.

COMETS.—M. Fayet has calculated the following extended ephemeris of Borrelly's comet for Greenwich midnight; it should be observable with powerful instruments for two or three months:—

	R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
March 2	7 9 33	63 56		
6	7 17 51	63 17	0·26483	0·09827
10	7 26 25	62 34		
14	7 35 13	61 49	0·27717	0·13347
18	7 44 7	61 1		
22	7 53 3	60 10	0·28939	0·16706
26	8 1 59	59 17		
30	8 10 54	58 22	0·30146	0·19918
April 3	8 19 46	57 26		
7	8 28 31	56 28	0·31333	0·22992
11	8 37 11	55 28		
15	8 45 42	54 28	0·32496	0·25932
19	8 54 6	53 26		
23	9 2 21	52 24	0·33635	0·28748
27	9 10 29	51 21		
May 1	9 18 29	50 18	0·34748	0·31443
5	9 26 22	49 14		
9	9 34 4	48 10	0·35834	0·34020

Lick Observatory Bulletin No. 320 contains an elliptical orbit of comet 1918*d* (Schorr) calculated by Mr. H. M. Jeffers from observations on November 25 and December 3 and 7, 1918:—

$$T = 1918 \text{ Oct. } 16{\cdot}442 \text{ G.M.T.}$$

$$\left.\begin{array}{l}\omega = 285^\circ\ 37'\ 0'' \\ \Omega = 118^\circ\ 32'\ 38'' \\ i = 5^\circ\ 19'\ 58''\end{array}\right\} 1918{\cdot}0$$

$$\phi = 25^\circ\ 35'\ 14''$$

$$\log a = 0{\cdot}512136$$

$$\mu = 605{\cdot}066''$$

$$\text{Period} = 5{\cdot}8641 \text{ years}$$

The time of perihelion is decidedly later, and the period shorter, than in the Copenhagen orbit.

"ANNUAIRE" OF THE BUREAU DES LONGITUDES.—This most useful little annual is so widely known that it is unnecessary to give an account of its main features. The essays vary from year to year; those in the present volume are: (1) The figures of relative equilibrium of a rotating homogeneous liquid, by P. Appell, and (2) The determination by interference of the diameters of heavenly bodies, by Maurice Hamy. (1) Treats the subject from an historical point of view, beginning with MacLaurin's ellipsoids of revolution, going on to those of Jacobi, with three unequal axes, then the tracing of the connection between these two classes and the investigation of the points of bifurcation; this leads on to the alternate direction of possible bifurcation, namely, the pear-shaped figures investigated by Liapounoff and Poincaré, many of which are illustrated in the text. Finally, the question of stability is dealt with, and the remarkable property of its interchange from one class of figures to another at the points of bifurcation. There is a very full bibliography. (2) Shows how the real diameters of such bodies as satellites and minor planets may be inferred from a study of their interference fringes. The following determinations (reduced to distance unity) are given as specimens:—Io, 4·90″; Europa, 4·35″; Ganymede, 6·40″; Callisto, 6·55″; and Vesta, 0·54″, or 250 miles. The author considers that with the Mount Wilson 100-in. reflector it might be possible to determine the angular diameters of 1st magnitude stars.

THE CHEMICAL DETECTION OF STRAIN IN IRON AND STEEL.

THE ninth volume of the Carnegie Scholarship Memoirs of the Iron and Steel Institute contains an account of an investigation on the above subject by Messrs. Whiteley and Hallimond, of the South Durham Steel and Iron Co. The research arose out of an observation made in the course of experiments in connection with the Eggertz test for combined carbon made by one of the authors. On examining the composition of the gases evolved when samples of steel were dissolved in dilute nitric acid, the authors noticed that the nitrous gases given off differed considerably in their proportions in the case of different samples. They were at first inclined to think that these variations were due to the influence of other elements, such as carbon and phosphorus, which are always present in steels. Later work, however, showed that the chief cause of the variations was the particular mechanical treatment to which the different samples have been subjected.

The paper is divided into two parts. In the first the authors discuss in some detail the chemical reactions involved, and the analyses of the gases formed when iron is dissolved in nitric acid. In the second they describe the changes in the reaction produced by mechanical work on various iron and steel samples, and show how the effect can be used to measure the progressive removal of cold work on annealing.

The reaction between nitric acid and various metals has been the subject of numerous investigations, among which may be mentioned those of Veley, Divers, Montemartini, and Stansbie. These researches deal mainly with copper, while iron has received much less attention. The authors point out that a variety of reduction products is obtained by the solution of metals in nitric acid. Nitrogen peroxide, nitric and nitrous oxides, nitrogen, ammonia, hydroxylamine, hydrogen, and hydrazine have all been obtained in proportions which depend on the metal used and the temperature and concentration of the acid. The complete analysis of such a mixture is both difficult and tedious. In the case of iron, however, the last three of the gaseous products just mentioned have not been detected, and the chief products requiring estimation are nitrogen peroxide, nitric oxide, nitrogen, and ammonia.

The authors describe a method of collecting and analysing the gases yielded by a 0·30 gram sample dissolved at 100° C. Under these conditions they assume that the whole of the iron is ultimately converted into ferric nitrate. They discuss the primary and secondary reactions which they consider occur; and, in particular, the interchangeability of nitrogen and ammonia with nitric oxide and nitrogen peroxide is shown. They find that the reaction of pure iron undergoes an almost discontinuous change at a certain acid strength (about 24 grams per 100 c.c.), and that much of the nitrogen and ammonia is replaced by nitric oxide and nitric peroxide as the acid strength increases from 23 to 25. These are the two main groups of products, and they find that the ratio between the iron equivalents given by the two groups is approximately independent of the secondary reaction between the members of each group. By plotting as ordinate the weight of iron consumed in forming nitrogen and ammonia, and as abscissa the acid strength in grams per 100 c.c., a characteristic curve is obtained which they term "the reaction curve," and this expresses the principal feature of the reaction.

In the second part of their investigation the authors examined in several typical cases the relation between the reaction curve and the degree of strain in the sample, and found that the curves are always shifted to the right with increase in strain. Wires deformed by twisting yielded progressively advancing reaction curves, and measurable changes in the gas analyses were found to be produced by an amount of energy which, if developed as heat, would not raise the temperature of the material 1° C. Similar curves were obtained with drawn wires. The results are interpreted by the authors as indicating that cold working takes places in two stages: (1) The elastically stressed crystals are brought into an interlocked condition; and (2) the crystal structure is then progressively broken up with the production of amorphous material.

The method has been used by the authors to investigate the removal of cold work from iron by heat treatment, and in the case of the sample used it was found to be complete at 520° C. The results described are of considerable interest, and the method appears to be one of decided promise. H. C. H. C.

THE MINISTRY OF HEALTH BILL.

THE text of the Ministry of Health Bill, already noted as having been presented to the House of Commons on February 17, has since been published. As foreshadowed by Dr. Addison in his speech to the members of the Medical Parliamentary Committee, prior to its introduction, the Bill differs little from the measure originally presented to the last Parliament. That it does differ to some extent, however, particularly in bearing signs of having been worked at and polished, is worthy of mention. The new Bill carries the stamp of finality, and suggests that most of the State Departments performing health functions—the Local Government Board, the Board of Education, and the Insurance Commissioners especially—have arrived at arrangements more or less agreeable to all parties. The position as between the two first-named, for example, is shown to be fairly easy. Even as regards the place to be taken by the Insurance Commissioners, there is less reason for dissatisfaction, and concessions no doubt have been made by the various bodies and individuals concerned. Speaking generally, the measure is a hopeful one, and inspires the feeling that we are well on the way to the establishment of the Ministry. The tone adopted by Dr. Addison is significant of this also, as is the translation of Sir George Newman to the Local Government Board, and the granting to him of the title of "Chief Medical Officer," with the status of a Secretary of the Board.

One part of the Bill which has been carried over unaltered from its predecessor is that relating to the appointment of consultative committees, and Dr. Addison, by his utterances, has shown himself to be firmly wedded to this idea, and expectant of results of great value from the work to be done by these bodies. Doubtless he has every right to be hopeful. The Consumers' Council at the Ministry of Food, which may be regarded as more or less analogous, though it was occasionally sneered at, must have assisted the Food Controller considerably. There is no reason to suppose that the Ministry of Health consultative committees will be any less helpful. Indeed, since they are to consist of carefully selected experts on matters having a bearing on national health, they are almost bound to be more valuable. In any event, the consultative committee idea has this to recommend it: that it will popularise health work. The committees will serve as a most effective link between the Department doing the work and those for whose benefit the work is done. The Department and the workers will be less cloistered; the workers and those who are worked for will be more intimately associated. The public will see and hear of what is being done, and will come to recognise the necessity for assisting in, and taking advantage of, the efforts made. So far there have been remarkably few comments on the Bill, but on the whole the reception has been entirely favourable.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE AND HORTICULTURE.

A. and C. Black, Ltd.—Black's Gardening Dictionary, edited by E. T. Ellis. *Macmillan and Co., Ltd.*—Science and Fruit Growing: Being an Account of the Results obtained at the Woburn Experimental Fruit Farm since its Foundation in 1894, the Duke of Bedford and S. Pickering. *John Murray.*—Hints to Farm Pupils, E. W. Lloyd.

ANTHROPOLOGY AND ARCHÆOLOGY.

John Murray.—Travels in Egypt and Mesopotamia in Search of Antiquities, 1886–1913, Dr. E. A. Wallis Budge, 2 vols., illustrated.

BIOLOGY.

A. and C. Black, Ltd.—A new edition of Studies in Fossil Botany, Dr. D. H. Scott, illustrated. *Blackie and Son, Ltd.*—Life and its Maintenance: A Symposium on Biological Problems of the Day, Prof. W. M. Bayliss, Dr. F. G. Hopkins, E. Margaret Hume, Prof. A. R. Cushny, K. J. J. Mackenzie, Dr. E. J. Russell, R. G. Stapledon, A. S. Horne, Prof. S. J. Hickson, A. G. Tansley, Lt.-Col. M. Flack, R. C. Maclean, Prof. F. W. Oliver, Dr. H. M. Vernon, and Prof. H. Kenwood. *P. Blakiston's Son and Co. (Philadelphia).*—A Classbook of Economic Entomology, Prof. W. Lochhead; Outlines of Economic Zoology, Prof. A. M. Reese; The Elements of Animal Biology, Prof. S. J. Holmes. *The Cam-*

bridge University Press.—Fossil Plants, Prof. A. C. Seward, vol. iv. (Cambridge Biological Series). *Constable and Co., Ltd.*—Animal Life and Human Progress, edited by Prof. A. Dendy; Utility Ducks and Geese, J. W. Hurst, illustrated; Forests, Woods, and Trees in Relation to Hygiene, Prof. A. Henry, illustrated. *The Epworth Press.*—British Ferns and How to Identify Them, J. H. Crabtree, illustrated (The "How to Identify" Series). *Hutchinson and Co.*—Bird Behaviour," F. Finn, illustrated; Insect Artisans and their Work, E. Step, illustrated (Hutchinson's Nature Library). *J. B. Lippincott Co.*—The Chromosome Theory of Heredity, Prof. T. H. Morgan; Inbreeding and Outbreeding: Their Genetic and Sociological Significance, E. M. East and D. F. Jones; Pure Line Inheritance, H. S. Jennings; The Experimental Modification of the Process of Inheritance, Prof. R. Pearl; Localisation of Morphogenetic Substances in the Egg, Prof. E. G. Conklin; Tissue Culture, R. G. Harrison; Permeability and Electrical Conductivity of Living Tissue, Prof. W. J. V. Osterhout; The Equilibrium between Acids and Bases in Organism and Environment, Prof. L. J. Henderson; Chemical Bases of Growth, Prof. T. B. Robertson; Primitive Nervous System, G. H. Parker; Co-ordination in Locomotion, A. R. Moore (Monographs on Experimental Biology and General Physiology). *Longmans and Co.*—The Quantitative Method in Biology, Prof. J. MacLeod, and a new edition of British Birds, A. Thorburn, illustrated, vols. iii. and iv. *Macmillan and Co., Ltd.*—Botany of the Living Plant, Prof. F. O. Bower, illustrated; A Text-book of Embryology, vol. ii., The Non-mammalian Vertebrates, Prof. J. Graham Kerr, illustrated. *John Murray.*—A new edition of Heredity, Prof. J. Arthur Thomson, illustrated. *George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.*—Timbers and their Uses, with a series of fine illustrations of grains of wood from new photographs; Germination, A. E. Baines, illustrated. *Skeffington and Son, Ltd.*—Birds and the War, H. S. Gladstone, illustrated. *The University Tutorial Press, Ltd.*—Text-book of Botany (Indian edition), J. M. Lowson, revised by Birbal Sahni. *T. Fisher Unwin, Ltd.*—Firewoods: Their Production and Fuel Values, A. D. Webster, illustrated; and a new edition of Instincts of the Herd in Peace and War, W. Trotter.

CHEMISTRY.

Baillière, Tindall, and Cox.—Fats, Waxes, and Essential Oils, W. H. Simmons; Coal-tar Dyes and Intermediates, E. de Barry Barnett; Explosives, including Matches and Pyrotechnics, E. de Barry Barnett; The Industrial Gases, Dr. H. C. Greenwood; Silica and the Silicates, J. A. Audley; The Rare Earths and Metals, Dr. E. K. Rideal; The Iron Industry, A. E. Pratt; The Steel Industry, A. E. Pratt; Gasworks Products, H. H. Gray; Animal Proteids, H. G. Bennett; Organic Medicinal Chemicals, M. Barrowcliff and F. H. Carr; The Petroleum Industry, D. A. Sutherland; Wood and Cellulose, R. W. Sindall and W. Bacon; The Carbohydrates, Dr. S. Rideal; Rubber, Resins, Paints, and Varnishes, Dr. S. Rideal (Industrial Chemistry Series). *Chapman and Hall, Ltd.*—Food: Its Composition and Preparation, M. T. Dowe and J. D. Jameson; Outlines of Theoretical Chemistry, Dr. F. H. Getman; Chlorination of Water, J. Race. *Constable and Co., Ltd.*—The Profession of Chemistry, R. B. Pilcher. *H. Holt and Co. (New York).*—College Text-book of Chemistry, Prof. W. A. Noyes. *Longmans and Co.*—Lead and its Compounds, Dr. J. A. Smythe; Liquid Fuel for Internal Combustion Engines, Sir Boverton Redwood, Bart., and Prof. J. S. S. Brame; Synthetic Colouring Matters: Sulphur Dyes, Prof. G. T. Morgan; Synthetic Colouring Matters: Vat Colours, Prof. J. F. Thorpe; Naphthalene, Prof. W. P. Wynne; Synthetic Colouring Matters: Azo-Dyes, Dr. F. W. Kay; Utilisation of Atmospheric Nitrogen: Synthetical Production of Ammonia and Nitric Acid, Prof. A. W. Crossley; Cement, B. Blount; The Principles and Practice of Gas Purification, E. V. Evans; Refractories, Dr. J. W. Mellor; Ozone and Hydrogen Peroxide: Their Properties, Technical Production, and Applications, Dr. H. V. A. Briscoe; Industrial Applications of the Rarer Metals, W. G. Wagner and W. E. F. Pewney; Cellulose-Silk, C. F. Cross; The Electric Arc in Chemical Industry, Dr. J. N. Pring; Organic Synthetic Reactions: Their Application to Chemical Industry, Prof. J. B. Cohen; Synthetic Colouring Matters: Triphenylmethane Dyes, Prof. R. Robinson; Synthetic Colouring Matters: Anthracene and Allied Dyestuffs, F. W. Atack; Synthetic Colouring Matters: Acridine and Xanthene Dyestuffs, Dr. J. T. Hewitt; Synthetic Colouring Matters: Azine and Oxazine Dyestuffs, Dr. J. T. Hewitt; Synthetic Drugs: Local Anæsthetics, Dr. W. H. Hurtley and M. A. Whiteley; Plantation Rubber, G. S. White; Corrosion and Decay of Metals, Prof. C. H. Desch (Monographs on Industrial Chemistry); Boiler Chemistry, J. H. Paul; The Rare Earth Metals, Dr. J. F. Spencer; Chemical Affinity and Chemical Equilibrium, Dr. H. S. Taylor; and a new edition of Osmotic Pressure, Prof. A. Findlay (Monographs on Inorganic and Physical Chemistry); and a new edition of A System of Physical Chemistry, Prof. W. C. McC. Lewis, vol. iii., Quantum Theory (Text-books of Physical Chemistry). *The University Tutorial Press, Ltd.*—Senior Practical Chemistry, H. W. Bausor.

ENGINEERING.

Constable and Co., Ltd.—Hot-bulb Oil Engines and Suitable Vessels, W. Pollock, illustrated; and new editions of Fuel, Water, and Gas Analysis for Steam Users, J. B. C. Kershaw; The Internal Combustion Engine: Being a Text-book on Gas, Oil, and Petrol Engines for the Use of Students and Engineers, H. E. Wimperis, illustrated; The Diesel Engine for Land and Marine Purposes, A. P. Chalkley, illustrated. *Longmans and Co.*—Aeroplane Structures, A. J. S. Pippard and Capt. L. Pritchard, with a preface by L. Bairstow, illustrated; Naval Architects' Data, I. Mitchell, edited by E. L. Attwood; Efficient Boiler Management, with Notes on the Firing of Coal-fired Reheating Furnaces, C. F. Wade; Ships' Boats: Their Qualities, Construction, Equipment, and Launching Appliances, E. W. Blocksidge.

GEOGRAPHY AND TRAVEL.

T. Fisher Unwin, Ltd.—In the Wilds of South America: Six Years of Exploration in Colombia, Venezuela, British Guiana, Peru, Bolivia, Argentina, Paraguay, and Brazil, Lieut. L. E. Miller, illustrated.

GEOLOGY AND MINERALOGY.

Chapman and Hall, Ltd.—Popular Oil Geology, V. Ziegler; Handbook of Mineralogy, Blowpipe Analysis, and Geometrical Crystallography, G. M. Butler. *H. Holt and Co. (New York).*—A new edition of Physiography, Advanced Course, Prof. R. D. Salisbury.

MATHEMATICAL AND PHYSICAL SCIENCES.

George Allen and Unwin, Ltd.—Introduction to Mathematical Philosophy, Hon. B. Russell. *Blackie and Son, Ltd.*—Applied Optics, vol. ii., The Computation of Optical Systems, being the "Handbuch der angewandten Optik" of Dr. A. Stenheil and Dr. E. Voit, translated and edited by J. Weir French. *The Cambridge University Press.*—Problems of Cosmogony and Stellar Dynamics, J. H. Jeans; Cambridge Astronomical Observations, vol. xxv. *Cassell and Co., Ltd.*—A new edition of Electricity in the Service of Man, Dr. R. M. Walmsley, vol. ii., section ii. *Chapman and Hall, Ltd.*—Analytic Geometry, M. M. Roberts and J. T. Colpitts; A Handbook of Physics Measurements, E. S. Ferry, O. W. Silvey, G. W. Sherman, jun., and D. C. Duncan, vol. i. Fundamental Measurements, Properties of Matter, and Optics, vol. ii. Vibratory Motion, Sound, Heat, Electricity, and Magnetism; Graphical and Mechanical Computation, Dr. J. Lipka; Mathematics for Engineers, W. N. Rose, part ii.; Graphic Dynamics, E. S. Andrews; and new editions of Descriptive Geometry, H. W. Miller, and Arithmetic for Engineers, C. B. Clapham. *Constable and Co., Ltd.*—A new edition of The Propagation of Electric Currents in Telephone and Telegraph Conductors, Prof. J. A. Fleming. *Longmans and Co.*—Applied Aerodynamics, L. Bairstow, illustrated. *Macmillan and Co., Ltd.*—Elementary Mensuration, Constructive Plane Geometry, and Numerical Trigonometry, P. Goyen, and a new edition of The Theory of Heat, T. Preston, revised by J. R. Cotter, illustrated. *The University Tutorial Press, Ltd.*—Intermediate Text-book of Magnetism and Electricity, R. W. Hutchinson; School Geometry (Matriculation Edition), A. G. Cracknell and W. P. Workman.

MEDICAL SCIENCE.

Baillière, Tindall, and Cox.—Injuries of the Head and Neck, Capt. L. Whale; The Heart: Past and Present, Dr. C. E. Lea; The Pituitary, Dr. W. Blair Bell. *John Bale, Sons, and Danielsson, Ltd.*—The Science and Art of Deep Breathing; Malaria and its Treatment in the Line and at the Base; Barbed Wire Disease; The Diseases of the New-born Child; The Essentials of Tropical Medicine; and new editions of The Surgical Treatment of Facial Neuralgia and The Prolongation of Life. *A. and C. Black, Ltd.*—Spas and Health Resorts of the British Isles: Their Mineral Waters, Climate, and the Treatment to be Obtained, Dr. T. D. Luke, illustrated; Cerebro-spinal Fever: The Etiology, Symptomatology, Diagnosis, and Treatment of Epidemic Cerebro-spinal Meningitis, Capt. C. Worster-Drought and Dr. A. M. Kennedy, illustrated; X-rays in General Practice: A Handbook for the General Practitioner and Student, Alice Vance Knox, with an introduction by Dr. R. Knox, illustrated (The Edinburgh Medical Series). *Cassell and Co., Ltd.*—The Story of English Public Health, Sir Malcolm Morris; The Housing Question, Dr. J. Robertson; The Welfare of the Infant and the Young Child, Prof. H. Scurfield; The Welfare of the School Child, Dr. H. J. Cates; The Welfare of the Expectant Mother, Dr. Mary Scharlieb; The Food Question, Dr. W. G. Savage (The Public Health Series); and a new edition of Elements of Surgical Diagnosis, Sir A. P. Gould and Dr. E. P. Gould, illustrated. *Constable and Co., Ltd.*—The Great War and the R.A.M.C., Lt.-Col. F. E. Brereton. *W. Heinemann (Medical Books), Ltd.*—Anaphylaxis and Antianaphylaxis, Dr. Bezredka, authorised English translation, edited and revised by Dr. S. R. Gloyne. *Longmans and Co.*—Tube Teeth and Porcelain Rods, J. Girdwood, illustrated. *Macmillan and Co., Ltd.*—Dr. John Fothergill and His Friends: Chapters in Eighteenth-century Life, Dr. R. H. Fox, illustrated. *Skeffington and Son, Ltd.*—Medical Research and Human Welfare: A Record of Personal Experiences and Observations during a Professional Life of Fifty-seven Years, Dr. W. W. Keen.

METALLURGY.

Constable and Co., Ltd.—A new edition of Malleable Cast Iron, S. J. Parsons.

METEOROLOGY.

Constable and Co., Ltd.—A new edition of Forecasting Weather, Sir Napier Shaw. *Methuen and Co., Ltd.*—Weather Study for Schools, E. Stenhouse.

PHILOSOPHY.

The Cambridge University Press.—Truth: An Essay in Moral Reconstruction, Sir C. Walston.

TECHNOLOGY.

Constable and Co., Ltd.—New editions of Glass Manufacture, Dr. W. Rosenhain; The Manufacture of Paper, R. W. Sindall; Wood Pulp, C. F. Cross, E. J. Bevan, and R. W. Sindall.

MISCELLANEOUS.

Constable and Co., Ltd.—Dictionary of Scientific Instruments, prepared by the British Optical Instrument Manufacturers' Association, illustrated; The Claims of Labour and of Capital, W. R. Cooper. *J. M. Dent and Sons, Ltd.*—New Town: A Proposal in Agricultural, Industrial, Educational, Civic, and Social Reconstruction, edited for the "New Town Council" by W. H. Hughes. *H. Holt and Co. (New York).*—The World's Food Resources, Prof. J. Russell Smith. *Macmillan and Co., Ltd.*—Annals of the Philosophical Club of the Royal Society, written from its Minute Books, Prof. T. G. Bonney. *Methuen and Co., Ltd.*—A Text-book of Hygiene for Training Colleges, M. Avery; School and Fireside Crafts, A. Macbeth, illustrated. *John Murray.*—Education, Secondary and University, Sir F. G. Kenyon. *George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.*—Routledge's Industrial Supremacy Books, dealing with agricultural machinery, commercial instruments, forestry, optical instruments, prepared foodstuffs, reproduction and utilisation of sound, shipbuilding, jig and tool making, testing machines, and watch and clock making; Handicrafts for the Handicapped, Dr. H. J. Buck and M. M. C. Buck, illustrated; The Science of Labour and its Organisation, Dr. J. Ioteyko; The Human Motor and the Scientific Foundations of Labour, Dr. J. Amar, with a preface by Prof. H. Le Chatelier, translated by E. Butterworth, the translation revised and edited by A. R. J. Ramsey, illustrated. *T. Fisher Unwin, Ltd.*—The Training of Youth: A Treatise on the Training of Adolescents, T. W. Berry.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Drapers' Company has resolved to continue its grant of 1000*l.* per annum towards the salaries of the professor of agriculture and the professor of agricultural botany for a period of ten years.

Mr. N. K. Adam, fellow of Trinity College, has been appointed to the Benn W. Levy research studentship in biochemistry for one year.

The Senate has approved a grace providing for the establishment of the degree of doctor of philosophy. The syndicate dealing with this question recommends that, subject to certain exemptions, candidates for the degree, before submitting a dissertation, must have pursued a course of research for not less than three years, and the Senate has determined that of this period one year in the case of a graduate of the University and two years in the case of other students must be spent in Cambridge.

The Adams prize, value 250*l.*, has been awarded to Prof. J. W. Nicholson, professor of mathematics at King's College, University of London.

Mr. Emile Mond has offered to give 20,000*l.* for the establishment of a Francis Mond professorship of aeronautical engineering in memory of Lieut. Mond, who was killed in action last year. The council of the Senate recommends that the offer be accepted with grateful thanks.

EDINBURGH.—Mr. Robert Kerr Hannay has been appointed professor of ancient history and palæography (Sir William Fraser chair) in succession to the late Prof. P. Hume Brown.

Dr. George Barger has been appointed to the new chair of chemistry in connection with medicine. Dr. Barger is at present research chemist to the Medical Research Committee, National Health Insurance. Previous to 1914 he was professor of chemistry in the Royal Holloway College, University of London.

The University Court has resolved, on the recommendation of the professor of natural history, to establish a chair to deal specially with the zoology of the invertebrates.

LIVERPOOL.—Two years ago Prof. and Mrs. Herdman gave to the University the sum of 10,000*l.* to establish a chair of geology in memory of their son, Lieut. George A. Herdman, who was killed in action. They have now made a further gift of 10,000*l.* for the purpose of establishing a chair of oceanography to embrace and continue the work of the fisheries laboratory at the University, the Port Erin Biological Station, and the scientific investigations of the Isle of Man Fishery Board and the Lancashire and Western Sea Fisheries Committee. The council of the University has accepted this generous benefaction with grateful thanks, and has resolved that (1) Prof. Herdman be appointed professor of oceanography as from October 1 next; (2) Dr. J. Johnstone succeed him on October 1, 1920, and during the twelve months from October 1 next be lecturer on oceanography at the salary derived from the endowment. The establishment of this chair is of particular scientific interest, not only because this is the first chair in the subject in the British Isles, but also because the donors intend it to be, in the main, a research chair, with applications to sea fisheries. The place and time are both most appropriate for work in these directions; and the University is fortunate in its association with Prof. Herdman, whose investigations for our fisheries during many years have been of high distinction, and whose generosity now enables them to be carried to further development for the advancement of science and the benefit of the nation.

MR. T. J. DRAKELEY, of the Wigan Mining and Technical College, has been appointed lecturer in chemistry at the Northern Polytechnic Institute, Holloway.

THE sum of 800*l.* has been given to the South-Eastern Agricultural College, Wye, by Mr. Figgis for the endowment of a scholarship in memory of his son, a former student of the college, who was killed in the war. Mr. A. H. Chaytor, of the University of Cambridge, has provided money for the equipment of a bacteriological laboratory at the college.

As the result of the appeal made in October last to friends of the late Mr. F. W. Rudler, a sum of 100*l.* was received, which has been invested in War stock and inscribed in the name of the University College of Wales, Aberystwyth. The annual income from this sum will be applied towards defraying the expenses incurred by deserving students of the Geological Department of the college on their "field excursions." This opportunity is taken of thanking the donors for their valued contributions.

SPEAKING at Oxford on Saturday last on "The Place of the University in National Life," Mr. H. A. L. Fisher, President of the Board of Education, said that the war has brought into clearer relief the fact that the universities and technical colleges have stood for a great deal in the national equipment during these times of stress and strain. No fewer than thirty university laboratories were made use of in 1918 in a single department of warfare. The fact that the State has become conscious of the value of the university as an integral constituent of national power acquires more and more significance. New legislation will affect the universities in three ways. It will fit a great number of men and women for university life, and so increase the number of candidates for the bachelor's degree. It will certainly create a greatly increased demand for teachers in State-aided schools. Lastly, it will create a new *clientèle* for extra-mural university teaching.

THE annual distribution of prizes and certificates to the students of the Sir John Cass Technical Institute, Aldgate, took place on February 18, when the awards were distributed by Dr. C. C. Carpenter, chairman of the South Metropolitan Gas Co. Sir Thomas Elliott, Bart., chairman of the governing body, presided. The Rev. J. F. Marr, chairman of the institute committee, in the course of an account of the work of the past session, stated that 242 students and 17 members of the staff had served with H.M. Forces during the war, of whom 15 had given their lives in the service of their country. In addressing the students, Dr. Carpenter said that institutions such as the Sir John Cass Technical Institute appealed to him very strongly, primarily because they allowed the ordinary vocations of life to be carried on during the ordinary working hours, while the evenings were devoted to the extension of knowledge, so that practical experience and responsibility were associated with a full training in the principles of the sciences which formed the basis of industrial experience and progress. He remembered, as a young man, being confronted with problems at the works which he was unable to see through, but he also had a vivid recollection of the sudden rays of light which were thrown upon that work after having had an opportunity, through a similar institution, of studying the science underlying the whole subject. He went on to point out the importance of lucid expression, the putting down of results in clear and concise language. He also urged students not to ignore the great value of an elementary training in freehand drawing in order to be able to make, in the same way that one would make a note of a process or a reaction, a note of the apparatus concerned. Dr. Carpenter complained of the inertia of English manufacturers as compared with German, in many instances it having been necessary to go to Germany when English manufacturers said certain requirements were impossible. That was one respect in which a great change must come over industry in Great Britain. The war had opened the eyes of manufacturers to the possibilities of what could be achieved by skilled and scientific management.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 13.—Sir J. J. Thomson, president, in the chair.—L. **Bairstow** and A. **Berry**: Two-dimensional solutions of Poisson's and Laplace's equations. Starting from a theorem stated in Lamb's "Hydrodynamics," problems involving solutions of Poisson's equation are interpreted in terms of the motion of the conventional inviscid fluid of hydrodynamics. The theorem states that the continuous acyclic motion of such a fluid inside or outside a rigid boundary can be reproduced by a system of sources round the boundary in all cases for which the fluid is at rest at infinity. The special point of the present paper is the formation and solution of an integral equation in order to find the strength of the sources. The answer appears as a series of integrals which is convergent in the four illustrations given; proof of convergency in the full mathematical sense is not attempted. The method of solution is applicable to boundaries of any shape and to more than one boundary. The integrals are easily obtained by graphical and mechanical methods.—Dr. G. H. **Thomson**: The cause of hierarchical order among the correlation coefficients of a number of variates taken in pairs. From the tendency towards "hierarchical" order among correlation coefficients in mental tests, the conclusion has in the past been drawn that all these correlations are due to the presence of a general factor, and that none of them are due to group-factors which run through two or more tests, but not through all. Although *perfect* hierarchical order can only be produced in this way, an approximation to perfection can be attained without any general factor by leaving the number and identity of the group and specific factors in each variate to chance. A card experiment is described in which this is done, and specimens of the resulting hierarchies are given. The proof depends on the formulæ of Pearson and Filon for the correlation of errors of correlation.—Dr. G. N. **Watson**: The transmission of electric waves round the earth. From Austin's experimental results it appears that the magnetic force due to a Hertzian oscillator varies as $\operatorname{cosec} \frac{1}{2}\theta \exp. (-A\lambda^{-\frac{1}{2}}\theta)$ at angular distance θ from the oscillator, where λ is the wave-length and, in the case of signals over the sea, the constant A has the value 9·6. It seems impossible to obtain any formula resembling this from a theory of pure diffraction, and it is therefore necessary to examine the hypothesis (put forward by Heaviside and others, and submitted to some analytical treatment by Eccles) that the upper regions of the atmosphere act as a reflector of the waves. It is found that a formula of Austin's type is a consequence of this hypothesis, and that the numerical value of A given by Austin is obtained by assigning suitable values to the conductivity of the reflecting layer and its height above the surface of the earth. The problem of waves over dry land is also considered and the appropriate value of A determined.

Geological Society, February 5.—Mr. G. W. Lamplugh, president, in the chair.—Dr. A. Logie **Du Toit**: The geology of the Marble Delta (Natal). The paper deals with the crystalline dolomitic marbles of Port Shepstone (Natal), rocks that have already been the subject of several communications to the society; but its main object is to demonstrate that certain "boulders" of alkali-granite, formerly regarded as inclusions, are in reality parts of intrusive tongues, and to discuss the mutual relations of the igneous rocks and the adjacent dolomites.

Linnean Society, February 6.—Sir David Prain, president, in the chair.—N. E. **Brown**: (1) A new species of Lobostemon in the Linnean herbarium; (2) Old and new species of Mesembryanthemum, with critical remarks. (1) Mr. C. C. Lacaita, in 1917, being engaged on a critical revision of Echium, directed the author's attention to a sheet written up by Linné as *Echium argenteum*, which upon examination could not be identified with any specimen at Kew or the British Museum, or even in herbaria at the Cape. It is entirely different from *Lobostemon argenteus*, Buek, syn. *Echium argenteum*, Bergius, with which Linné supposed it to be identical. This single specimen, collected at least 147 years ago, does not appear to have been found by any other collectors since that date. The locality given, "montibus nigris," by Linné, is Zwartberg, as confirmed by Governor Tulbagh's list (Proc. L.S., 1917–18, Suppl., p. 10), where it is No. 145—these figures appearing on the sheet itself, and in the list written up as *Echium fruticosum*, a name abandoned before publication. (2) This paper gave the history of the genus Mesembryanthemum from the time of Adrian H. Haworth, between 1794 and 1821, who published four monographs of the genus, described mostly from living plants, cultivated by himself or at Kew. His short descriptions are insufficient for identification, but happily a large number of his species are represented by a series of coloured drawings by George Bond and Thomas Duncanson, two artists employed at Kew between 1822 and 1835 to make drawings of the plants cultivated there. The result is that many hundreds of excellent drawings are in existence at Kew, but unpublished and practically unknown, and the attention of botanists is directed to them, about one-fourth of them being of species of Mesembryanthemum.

Optical Society, February 13.—Prof. F. J. Cheshire, president, in the chair.—Lord **Rayleigh**: The possible disturbance of a range-finder by atmospheric refraction due to the motion of the ship which carries it. It was stated that the suggestion had been put forward that the action of a range-finder adjusted for a quiescent atmosphere may be liable to disturbance when employed upon a ship in motion, as a result of the variable densities in the air due to such motion and the consequent refraction of the light. The question arises as to the direction and magnitude of the effect, and whether or not it would be negligible in practice. This question was treated mathematically in the paper.—L. C. **Martin** and Mrs. C. H. **Griffiths**: Deposits on glass surfaces in instruments. The first section of the paper contained a summary of the various phenomena that have been described under the name of "film." In instruments deposits occur most frequently on the graticules, and a discussion is given as to the probable action of the lubricants in bringing about the formation of the deposit. The qualities desirable in a lubricant to be used on optical instruments are also enumerated, and a brief summary is made of the results of hitherto published information on the subject of the deposits. The second section gives a short classification of the deposits according to their microscopic appearance, and describes a series of experiments made to test the cause of the formation of the deposit. The experiments were conducted by means of brass cells into which graticule blanks were fitted as windows, these glass surfaces being examined microscopically during the course of the experiments.

Royal Meteorological Society, February 19.—Sir Napier Shaw, president, in the chair.—Dr. S. **Chapman**: The lunar tide in the earth's atmosphere. The lunar tidal variation of barometric pressure has been well determined at Batavia, from fifty years' hourly record, and from shorter series of data, extending over about five years in each case at St.

Helena, Singapore, Rome, and Samoa. As very little was known about its dependence on latitude, season, and the distance, declination, and phase of the moon, a new and detailed discussion has been made of thirty and twenty-eight years' records of barometric pressure at Batavia and Hong Kong respectively. The results are described in this paper, and considered alongside the pre-existing values from the stations above-named, together with the Greenwich determination recently published in the Quarterly Journal of the society. It appears that the amplitude varies approximately as the fourth power of the cosine of the latitude, while the phase varies somewhat irregularly from 33° (Samoa) to 114° (Greenwich), where 90° corresponds with the occurrence of maximum pressure when the moon is on the meridian. No dependence on lunar phase or declination was detected, while as regards the moon's distance, an increase of amplitude from apogee to perigee was observable, though less than the increase in the tide-producing force. Distinct evidence of a seasonal variation of amplitude and phase was shown by both the Hong Kong and Batavia determinations. The conclusion drawn from the various results is that the lunar atmospheric tide is not a simple tidal phenomenon, but is complicated by other effects, notably by resonance with an adjacent free period of vibration of the atmosphere, and possibly also by more local causes, such as the rise and fall of the ocean.—M. **Christy**: The gunfire on the Continent during 1918: its audibility at Chignal St. James, near Chelmsford. Observations on the audibility of the Continental gunfire have been made by the author for four years. The results for previous years were brought forward in earlier papers. In 1918 the first sounds were heard on the evening of May 8 and the last on August 26, thus confirming previous experience that there is audibility at the writer's post of observation in Essex only during the summer months. The period of audibility in 1918 amounted to 15 weeks, 5 days. In previous years the periods were: 1915, 17 weeks, 3 days; 1916, 15 weeks; 1917, 19 weeks, 4 days. The average for the four years is 17 weeks. A feature of 1918 was that the sounds were less loud and distinct than in previous years, and there were none of the periods of extreme loudness which had been noticed before.

SHEFFIELD.

Society of Glass Technology, February 19.—Mr. J. Connolly in the chair.—J. D. **Cauwood**, Constance **Muirhead**, and W. E. S. **Turner**: The properties of the lime-soda glasses: (2) The resistance to water and other reagents. Several glasses had been melted on a small scale, and the lime content increased by definite amounts. The resistance of each glass to the following reagents—water, caustic soda solution, sodium carbonate solution, hydrochloric acid—had been tested. In every case it was found that increasing the lime content brought about increasing resistance.—S. **English** and W. E. S. **Turner**: The properties of the lime-soda glasses: (3) The thermal expansions. The same series of glasses mentioned above (*i.e.* lime contents increasing to 10 per cent.) had been tested in regard to thermal expansion. It had been proved that the expansion decreased as the lime content increased. Both papers proved the value of lime as a constituent of ordinary glasses.—Prof. P. H. **Boswell**: Impressions of the glass industry of the United States gathered on a recent visit. The author dealt first with the supplies of raw materials as found in the States. Six sands were in general use; one of them, a beautiful sand from Rockwood, Detroit, was used exclusively for optical glass. The American "sands" are not found as such, but in the form of sandstone (fairly soft). This is blasted, washed by water, under pressure, into the bottom of the pit, whence it is dredged up to the top of the pit. It is emptied into concrete bins, and works down through steam pipes until it emerges as dry, clean-running sand. Prof. Boswell afterwards dealt briefly with American supplies of potash and felspar, and then passed on to the question of refractories. He showed a specimen of a glasshouse pot which had been developed by Dr. Bleininger, and this pot, after the melt had been performed, was perfectly white in colour and very close in texture. In making their pots the Americans were substituting Cornish kaolin by kaolin from Georgia, and using ball clays from Tennessee and Kentucky in place of those from Devon and Cornwall.

PARIS.

Academy of Sciences, February 10.—M. Léon Guignard in the chair.—The president announced the death of Jean Jacques Théophile Schlœsing, member of the section of rural economy and the oldest member of the Academy.—A. **Lacroix**: Dacites and dacitoïdes, with reference to the lavas of Martinique. The name dacitoïde is proposed for a class of minerals hitherto classified as andesites and allied to dacites. Twelve complete analyses of Martinique minerals are given and discussed from the point of view of this new classification.—J. **Bergonié**: The reconstitution of isolated muscles or of muscular groups by intensive rhythmic faradisation. The method has special reference to the treatment of wounded men; it causes no nervous fatigue, and for the greater part of the time of application is not felt. The improvement in many directions is marked.—M. Jean Effront was elected a correspondant for the section of rural economy in succession to M. Leclainche, elected member of the section.—L. **Roy**: The dynamical resistance of steel.—A. **Sanfourche**: The oxidation of nitric oxide by dry air. The rate of oxidation of nitric oxide was studied over a range of temperatures from −50° C. to 450° C. The first stage of oxidation, to nitrous anhydride, is very rapid, and is unaffected by temperature. The oxidation of nitrous anhydride to nitrogen peroxide is a reversible reaction, takes an appreciable time, and the rate is dependent on the temperature if above 200° C.—L. **Joleaud**: The migrations at the neogene epoch of Hipparion, Hippotraginæ, and Tragelaphinæ.—M. **Rouch**: The land and sea breezes at Bayonne.—M. **Mirande**: The microchemical reactions and localisations of the alkaloid of *Isopyrum thalictroides*.—J. **Pantel**: The *rôle* of calcium in the mineralisation of the nucleus of the excreting cells in the Phasmides.—R. **Fosse**: The formation, by oxidation of organic substances, of an intermediate term spontaneously producing urea. Proteins and amino-acids, oxidised by potassium permanganate by Béchamp's method, give appreciable proportions of urea, and the amounts are increased if ammonia is present. The urea formed is separated and estimated by the xanthydrol method previously described by the author.—Em. **Bourquelot** and M. **Bridel**: The biochemical synthesis, with the aid of emulsin, of the β-glucoside of α-naphthyl alcohol.—E. **Debains** and E. **Nicolas**: The causes of death in horses immunised with dead bacteria or bacterial extracts.

MELBOURNE.

Royal Society of Victoria, November 7, 1918.—Mr. J. A. Kershaw, president, in the chair.—R. T. **Patton**: Notes on fossil Eucalypt leaves from the Tertiary at Bulla.—Dr. E. F. J. **Love**: The real significance of the

Michelson-Morley experiment.—Prof. A. J. **Ewart**: (1) Contributions to the flora of Australia. No. 27. (2) The synthesis of sugars from formaldehyde. A detailed account was given of the polymerising action of various alkalis on formaldehyde, and also of the influence of temperature, dilution, etc. In the presence of a calcium salt the polymerising action of sodium hydrate is greatly increased, and evidence is brought forward to show that the polymerising action is analogous to that of a condensing enzyme.

December 12, 1918.—Mr. J. A. Kershaw, president, in the chair.—F. **Chapman**: New or little-known fossils in the National Museum. Part xxiii.: Some Hydroid remains of Lower Palæozoic age from Monegetta, near Lancefield. These are well-preserved specimens, and are referred to the order Calyptoblastea. Two new genera and four new species are described. The genera represented are Mastigograptus, Ruedemann, Archæolafoëa, gen. nov., and Archæocryptolaria, gen. nov. Gonothecæ appear to be present in three of the forms. The horizon is the lowest in the Ordovician.—R. T. **Patton**: The structure, growth, and treatment of some common hardwoods. Attention was directed to the core-wood of some hardwoods which are soft and sappy, such as is shown by timber grown in excessive shade, the result of overcrowding whilst young. The author showed that there was no advantage in stacking timber on end, and gave the rates of drying of timber cut in various ways. The electrical resistance of a piece of timber determined whether it was properly seasoned. Estimates of the growth and timber yield of mountain ash and Messmate were explained in the form of curves, from which the forest yield at various ages could be predicted.—J. T. **Jutson**: The sand-ridges, sand-plains, and sand-glaciers at Comet Vale, in sub-arid Western Australia. The physical features of Comet Vale, sixty miles north of Kalgoorlie, include a portion of a "dry lake" (Lake Goongarrie), and a belt of rocky "high" lands on its western shore composed of ferruginous laterite and "greenstones," and dissected by narrow valleys. North, north-west, and east are extensive sand-plains with ridges trending east and west. Immediately to the west of the "high" lands a sand-plain slopes gently to the west. The sand drifts eastward through some "passes" in a laterite ridge (the western end of the "high" land area) and spreads out as "sand-glaciers," according to the term used by Free. The sand forming the smooth sand-plain and glaciers is wind-borne. This will probably explain the origin of extensive sand-plains elsewhere in Western Australia. The eastward march of the sands has blotted out the drainage lines to the west of the "high" lands.—Dr. C. **Mackenzie** and W. J. **Owen**: Note on the parathymus gland in the marsupial. Three glands new to science in the Platypus have lately been described by the authors. One of these, the parathymus, has since been described by them in the Tasmanian Devil, in which it is larger than in the Platypus.—N. C. B. **Allen** and Prof. T. H. **Laby**: The sensitivity of photographic plates to X-rays.

SYDNEY.

Linnean Society of New South Wales, September 25, 1918.—Prof. H. G. Chapman, president, in the chair.—Prof. W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales. Part viii.: The extension of the Great Serpentine Belt from the Nundle district to the coast.—G. I. **Playfair**: New and rare fresh-water Algæ. Sixty-six new forms are described and figured, twenty-eight being admitted to specific rank, twenty-nine classed as variations, and nine as forms; one genus is proposed as new.—Dr. J. **Shirley** and C. A. **Lambert**: The stems of climbing plants. Abnormal stem-structures in climbing plants have for their object the free flow of elaborated sap in the bast-tissues. Seven classes of Dicotyledons and two of Monocotyledons are proposed, based on the arrangement of the tissues concerned.—Dr. V. F. **Brotherus** and the Rev. W. W. **Watts**: The mosses of North Queensland. Being essentially Malaysian, rather than Australian, in their affinities, the number of new species was smaller than was anticipated. Seventeen genera new to Australia are listed, and some thirty known species. One genus and fourteen species are described as new.—Dr. R. J. **Tillyard**: Mesozoic insects of Queensland. Part iv. Hemiptera Heteroptera: the family Dunstaniidæ. With a note on the origin of the Heteroptera. Originally described in 1916 as a Lepidopteron by the author, the fossil *Dunstania pulchra* has created considerable interest and discussion. This paper, first of all, gives an account of the various suggestions that have been put forward as to its true affinity, and shows that opinions have favoured its relationship with no fewer than four orders (Lepidoptera, Homoptera, Diptera, and Plectoptera). Having definitely rejected all these, the author only found the true solution from the study of more recently discovered material from the same Upper Triassic beds at Ipswich, Queensland. These prove that the family Dunstaniidæ belongs to the Hemiptera Heteroptera. The new material is described and placed in two new genera, Dunstaniopsis and Paradunstania, each containing a single new species. The venation is worked out by comparison with the nymphal tracheation of a recent Heteropteron (Syromastes sp.). Finally, in considering the origin of the Heteroptera, the author shows that the Dunstaniidæ are closely related to the Permian fossil Prosbole, placed by Handlirsch in a separate order, Palæohemiptera. This order is considered to be only a sub-order within the Hemiptera; and the Dunstaniidæ, which are true Heteroptera, are derived from the immediate ancestors of Prosbole, not from Prosbole itself.

Royal Society of New South Wales, December 4, 1918. —Mr. W. S. Dun, president, in the chair.—Marguerite **Henry**: Some Australian Cladocera. The fresh-water Crustacea dealt with in this paper were collected at Kendall, Cumbalum, Casino, and Byron Bay on the north coast; in the neighbourhood of Sydney; and at the Lett River, Blue Mountains, Port Stephens, Bathurst, Mudgee, and Corowa. Twenty-six species were found, of which nine are described as new.—J. H. **Maiden**: Notes on Eucalyptus (with descriptions of two new species in co-operation with Mr. R. H. Cambage). No. vi. One of the two new species described is a Box from just south of the Gulf of Carpentaria, the other a Stringybark from the Blue Mountains, long confused with *E. capitellata* originally described from Port Jackson. The Flooded Gum of the coastal districts is proposed to be raised to the rank of a species, following an almost forgotten suggestion of Mr. Walter Hill, of Brisbane, made many years ago. It is suggested that Müller's abandoned name for the morrel-tree of Western Australia should be revived, and a remarkable variety of *E. pyriformis* is described from the interior of that State. The paper contains a number of critical notes in regard to the distribution and morphology of Australian gum-trees.—Dr. T. H. **Johnston** and Miss M. **Bancroft**: Some new sporozoon parasites of Queensland fresh-water fish. On various occasions there have broken out in western Queensland serious epidemics amongst the fresh-water fish, resulting in their wholesale destruction, and, as a result, pollution of the water supply has taken place. The authors have investigated the outbreak in order to determine its cause. They have been engaged in field work, and in the course of their inquiry came across a number of minute protozoon parasites of fishes. These tiny parasites form cysts in various organs of the body, particularly in the gills. They do not seem to have any marked detrimental effect on their hosts. The parasites are distributed amongst five distinct genera, all belonging to the Sporozoa. Of these five genera only one had been previously recorded from Australia.—H. G. **Smith**: The occurrence of the terpene terpinene in the oil of *Eucalyptus megacarpa*. This somewhat rare terpene has not previously been detected in eucalyptus oils. The oil of this species consists principally of terpenes with about 30 per cent. of cineol (eucalyptol) and a small quantity of the esters geranylacetate and butylbutyrate. The characteristic terpinenenitrosite, m.p. 155° C., was prepared without difficulty. It is interesting that terpinene should occur in a species belonging to the earlier portion of the genus Eucalyptus and in Western Australia, while the corresponding terpene phellandrene is found in the oils of the more recent species growing in the south-eastern portion of the continent.

BOOKS RECEIVED.

The Drift to Revolution. (Papers for the Present. Third series. No. 9.) Pp. 52+iv. (London: Headley Bros., Ltd., 1919.) 1s.

The Strawberry in North America: History, Origin, Botany, and Breeding. By Prof. S. W. Fletcher. Pp. xiv+234. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) 8s. net.

Le Nubi. By Luigi Taffara. Parte prima. Pp. 67. Parte ii., Atlante (plates). Tav. xxvi. (Roma: Tipografia Ditto L. Cecchini, 1917.)

Joys of the Open Air. By William Graveson. Pp. 115. (London: Headley Bros., Ltd., n.d.) 3s. 6d. net.

America at School and at Work. By Rev. Dr. H. B. Gray. Pp. xx+172. (London: Nisbet and Co., Ltd., 1918.) 5s. net.

The Spiritual Foundations of Reconstruction: A Plea for New Educational Methods. By Dr. F. H. Hayward and Arnold Freeman. Pp. lxi+223. (London: P. S. King and Son, Ltd., 1919.) 10s. 6d. net.

Dynamics. Part ii. By R. C. Fawdry. (Bell's Mathematical Series.) Pp. viii+179-355+vii. (London: G. Bell and Sons, Ltd., 1919.) 2s. 6d.

The A B C of Aviation. By Capt. V. W. Pagé. Pp. xii+13-274+7 plates. (New York: The Norman W. Henley Publishing Co.; London: Crosby Lockwood and Son, 1918.) 12s. 6d.

Standard Tables and Equations in Radio-telegraphy. By Bertram Hoyle. Pp. xiv+159. (London: The Wireless Press, Ltd., 1919.) 9s. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Prof. H. M. Lefroy: How Silk is Grown and Made.

ROYAL SOCIETY, at 4.30.—Hon. R. J. Strutt: Scattering of Light by Solid Substances.—Sir James Dobbie and Dr. J. J. Fox: The Constitution of Sulphur Vapour.—Dr. W. G. Duffield, T. H. Burnham, and A. H. Davis: The Pressure upon the Poles of the Electric Arc.

CHILD-STUDY SOCIETY, at 6.—Dr. P. B. Ballard: The Claim of the Individual Child.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. S. F. Barclay and Dr. S. P. Smith: The Determination of the Efficiency of the Turbo-alternator.

FRIDAY, FEBRUARY 28.

PHYSICAL SOCIETY, at 5.—Philip R. Coursey: Simplified Inductance Calculations, with Special Reference to Thick Coils.—Dr. Ralph Dunstan; Demonstration of Some Acoustic Experiments in Connection with Whistles and Flutes.—G. A. Brodsky: Demonstration of a New Polariser.

ROYAL INSTITUTION, at 5.30.—Sir Oliver Lodge: Ether and Matter.

SATURDAY, MARCH 1.

ROYAL INSTITUTION, at 3.—Hon. J. W. Fortescue: The Empire's Share in England's Wars—Eastern Europe.

MONDAY, MARCH 3.

VICTORIA INSTITUTE, at 4.30.—M. J. Rendall: The Vocation of a Teacher.

ARISTOTELIAN SOCIETY, at 8.—Mrs. N. A. Duddington: Our Knowledge of Other Minds.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—*Adjourned Discussion*: A. R. Ling: Refractometry and its Applications in Technical Analysis.—*Papers*: F. Esling: Notes on the Setting Time of Portland Cement.—Dr. G. H. J. Colman and E. W. Yeoman: The Determination of Benzol, Toluene, etc., in Coal Tar and similar Products.—Dr. P. E. Spielmann and F. Butler Jones: Estimation of Carbon Disulphide. A Critical Examination of the Various Methods usually employed.

TUESDAY, MARCH 4.

ROYAL INSTITUTION, at 3.—Prof. H. Maxwell Lefroy: How Silk is Grown and Made—Mulberry Silk.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. J. C. McLennan: Science and Industry in Canada.

ZOOLOGICAL SOCIETY, at 5.30.—Dr. J. A. Murray: Report on the Deaths in the Gardens during the Year 1918.—G. A. Boulenger: A Collection of Fishes from Lake Tanganyika, with Descriptions of Three New Species.—Miss Joan B. Procter: The Skull and Affinities of *Rana subsigillata*, A. Dum.

WEDNESDAY, MARCH 5.

ROYAL SOCIETY OF ARTS, at 4.30.—B. D. Porritt: The Rubber Industry—Past and Present.

GEOLOGICAL SOCIETY, at 5.30.—Col. T. W. Edgeworth David: Geology at the Western Front.

ROYAL AERONAUTICAL SOCIETY, at 8.—Capt. A. P. Thurston: The All Steel Aeroplane.

THURSDAY, MARCH 6.

ROYAL SOCIETY OF ARTS, at 4.30.—W. R. Gourlay: The Need for a History of Bengal.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

CHILD-STUDY SOCIETY, at 6.—Miss S. Walker: The Training of Teachers from the Child-Study Standpoint.

CHEMICAL SOCIETY, at 8.—Prof. J. W. Nicholson: Emission Spectra and Atomic Structure.

FRIDAY, MARCH 7.

ROYAL INSTITUTION, at 5.30.—Prof. H. C. H. Carpenter: The Hardening of Steel.

SATURDAY, MARCH 8.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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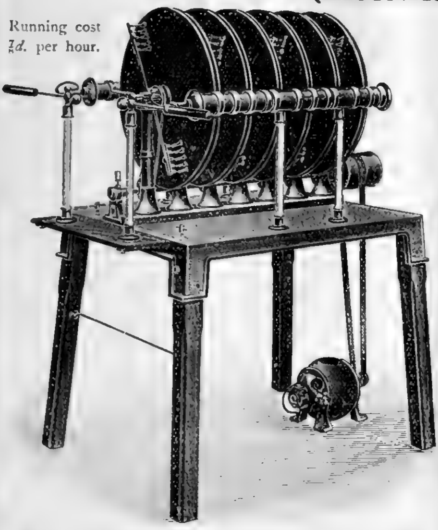

☛ *See article, "Development and Uses of the Static Electrical Machine,"* NATURE, *December 27, 1917, page 332.*

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