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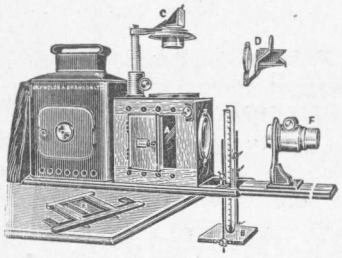

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THURSDAY, JANUARY 6, 1916.

MERIT AND REWARD.

ON several occasions last year, the Premier and other members of the Government said in the House of Commons that the services rendered by scientific men in connection with war problems had been of high national value. It was acknowledged in the same place last July that practically all the laboratories in the country had been placed at the disposal of the War Office, which had derived great benefit from advice and information received from the Royal Society, the National Physical Laboratory, the universities, and other bodies; and opportunity was then taken to convey the thanks of the Army Council to these scientific and learned bodies.

Recent events have indeed brought men of science into closer relationship with national affairs than ever before, and some attempts have been made to organise their efforts. We give elsewhere in this issue a list of scientific committees appointed by the Government and various societies to assist the country in the present crisis. It will be noticed that in most cases, whether of Government panels of consultants or committees of scientific societies, the services rendered are gratuitous. No particular publicity has been given to this fact; and the majority of people are, therefore, unaware that the best expert scientific and technical knowledge has thus been placed freely at the disposal of the Government. As most scientific work is done for the good of the community instead of the personal profit of the individual, it is usually assumed officially that no payment need be made for it. The reverse is the case in other professions, where expert advice is never expected unless adequate fees are forthcoming. We were given several notable examples of this in a statement issued by the Treasury a few days ago, showing the payments made to the Law Officers of the Crown since 1905. The total amount received by these officers during this period was nearly 250,000*l*. In the year 1912–13 Sir Rufus Isaacs received 16,762*l*. as Attorney-General, and in the year 1913–14 Sir John Simon was paid 14,303*l*. We are glad that attention has been directed to these generous emoluments for legal services, which are essentially non-productive and unprofitable; and we believe that when the public has been sufficiently enlightened as to the relative values of national work in law and science, a readjustment of the rewards made for it will be demanded.

We anticipated that the publication of the list of New Year Honours would show definite public recognition of the national importance of science by the award to a number of leading and representative scientific workers of the distinctions which the country has to bestow. It was reasonable to have this expectation, since, as we have said already, no payment is made to the men of science who have been called in to assist the State with expert advice and judgment. We have now the list of New Year Honours before us; and among the scores of names we do not find a single honour given specifically for scientific work. Several men of science engaged in Government departments, as well as leading surgeons and physicians, are selected for various honours, but outside what may be termed official circles, science is practically ignored.

Many of the honours are rightly given for valour or distinguished action during the present war, but the services rendered by scientific men in order to make the nation strong enough for battle on land or sea under modern conditions are forgotten. It would not be supposed, from the list of honours, that science had anything to do with the war, yet every branch of the Army, Navy, and Medical Services is dependent upon it; and there never was greater need than now of making the utmost use of all that science can offer. Chemists have directed the manufacture of high explosives and fine chemicals urgently needed, and have provided means of protection from poisonous gases; electricians have made it possible for aeroplanes and airships to use wireless telegraphy as a means of rapid communication of intelligence to field stations at a distance of thirty miles or so; mathematical research and physical experiment are responsible for the designs of our most stable aeroplanes; optical science gives our battleships range-finders which will enable ranges to be determined within fifty to a hundred yards at a distance of a dozen miles; and, thanks to the adoption of scientific methods, the incidence of disease among our troops in France has been far lighter than in any previous campaign. It would be easy to multiply these applications of science to modern warfare many times, but national recognition of them is still to be sought.

The honours list includes six new peers; and we are disappointed, rather than surprised, not to find the name of a representative of science among them, though no scientific men have been called to the peerage to fill the gaps caused by

the deaths of Lord Kelvin, Lord Lister, and Lord Avebury. There are six new Privy Councillors, and three new members of the Privy Council in Ireland; and of the nine, all except one are, or have been, members of the House of Commons, including two Labour members. The total disregard thus shown to the power which scientific men can bring into the chief council of our Sovereign is characteristic of the political mind which advises his Majesty in the selection of men worthy of the honour. The work of science is unknown to political circles; and the road to the Privy Council is not through Burlington House or other centres where scientific men add their contributions to the store of knowledge by which alone can national greatness be ensured, but through Parliament and the market-place, where distinction is not gained by producing-power, but by persuasive rhetoric.

From the national point of view, the Privy Council should include many men of distinguished eminence in pure and applied science, whereas, now that Sir Henry Roscoe is dead, there is not a member of the Council who can be specially regarded as a representative of science. We suppose that this accounts for the fact that the committee of the Council appointed to administer the moneys voted by Parliament for the development of scientific and industrial research does not include a single man of science. Scientific and industrial experts constitute a council to advise the committee, but are naturally subordinate to it. In a State which used true standards of value, each of these experts would be a member of the Privy Council instead of being under the control of a committee which knows nothing whatever of the technical difficulties to be faced. In this country, under the pressure of public opinion, our ministers appoint advisory committees of men of science and engineers for war problems connected with the Ministry of Munitions, Admiralty, the Board of Trade, and other departments of State; but, whereas all the members of these committees would have been made Privy Councillors in Germany, not a single one is given the like honour here. Yet the *Times* can refer to "an exceedingly catholic selection of new Privy Councillors, among whom Mr. Will Crooks is perhaps the most notable and the nearest in accord with the spirit of the time."

We need not attach much importance to the phrase used by our contemporary; yet it is true of the world bounded by the political horizon, where votes count for more than genius. True also it is, and characteristic of the spirit of the time as embodied in the daily papers, that, so far as we have seen, not a single reference has been made to the almost complete absence of the names of scientific men from the list of honours, and the usual satisfaction has been expressed at the selection. The indifference thus shown to science, when all its resources are needed for the successful prosecution of the war in which we are engaged, and for the industrial conflict to follow it, makes us wonder whether our statesmen are capable of understanding what scientific work means to a nation. We live in a scientific age, yet we are governed by men who belong to a century ago; and in their hands, unfortunately for national dignity, lies the division of national honours and emoluments. "Honour and glory and power" are thus much easier won by engaging in politics or commerce than by a career devoted to science. All the benefits of modern civilisation are due to the achievements of science or inventions based upon them; but neither the multitude nor its masters in politics or industry are familiar with the names of the men whose work has provided the comforts and the strength of the present day. While this condition of things persists, science cannot reasonably hope that its meritorious services to the State will receive enlightened attention or just reward.

THE BRITISH COAL-TAR INDUSTRY.

The British Coal-Tar Industry: Its Origin, Development, and Decline. Edited by Prof. W. M. Gardner. Pp. ix+437. (London: Williams and Norgate, 1915.) Price 10*s.* 6*d.* net.

IN this volume Prof. Gardner has collected a series of lectures and addresses delivered on the British coal-tar industry and allied subjects during the last fifty years. These discourses fall naturally into two categories, those delivered before the war and those dealing with the problem of the shortage of dyes arising from the war.

The first three lectures of the earlier series are, very appropriately, the Cantor Lectures of 1868 on the aniline or coal-tar colours by Sir William Perkin, the discoverer of mauve or aniline purple, the first synthetic dye. Successive discourses by other lecturers at first indicated a satisfactory development of the youthful industry in England and France, but in 1881 a note of warning was sounded by Sir Henry Roscoe, the subject being indigo and its artificial production, when the lecturer pointed out that, while the raw materials of the synthetic dye industry were produced in England, the conversion of these crude substances into finished and valuable colours was very largely

effected in Germany. He attributed this early success of the German competitors to three causes —the cultivation of organic chemistry, the recognition of the value of scientific training, and the adverse influence of the English law of patents.

From this time onwards the lecturers assume the part of chemical Cassandras, foretelling to unheeding ears the decline of the British coal-tar colour industry. In 1885 the discoverer of mauve dealt with the matter, alleging that the patent laws, the fiscal policy of Great Britain, and the disinclination of British manufacturers to employ well-trained chemists were causes militating against the commercial success of the industry.

Prof. Meldola, in discussing the scientific development of the industry up to the year 1886, advised the English manufacturer "to look after the science and leave the technique to take care of itself." .

The effect of scientific research on the cost of the dyes was strikingly brought out in the Hofmann Memorial Lecture delivered in 1896, when it was stated that magenta, which was formerly worth three guineas an ounce, could then be bought at 2*s*. 9*d*. per pound. An instructive summary of the relative progress of the industry in England and Germany during the period 1886–1900 was given by Prof. Green in a paper to the British Association in 1901. In this publication the author denounced in scathing terms the English manufacturer who "considered that a knowledge of the benzol market was of greater importance than a knowledge of the benzol theory," and the conclusion was drawn that "it is not so much the education of our chemists which is at fault as the scientific education of the public as a whole."

The indigo crisis arose in 1901, when it was realised that the problem of the artificial production of indigotin had been successfully solved. The history of this wonderful achievement, involving many years of intellectual labour and organised scientific team-work, was narrated by Dr. Brunck at the opening of the Hofmann House in Berlin in 1900. A translation of his lecture is given almost *in extenso*.

A portion of the Presidential Address to the British Association in 1902 is devoted to the topic of "applied chemistry, English and foreign." Read in the light of recent events, Sir James Dewar's words have a knell of prophecy fulfilled. "To my mind, the really appalling thing is not that the Germans have seized this or the other industry, or even that they may have seized upon a dozen industries. It is that the German population has reached a point of general training and specialised equipment which it will take us two generations of hard and intelligently-directed educational work to attain. It is that Germany possesses a national weapon of precision which must give her an enormous initial advantage in any and every contest depending upon disciplined and methodised intellect."

In 1905 Prof. Meldola disposed of the plea that the colour industry declined in England for want of duty-free spirit. Incidentally he also demonstrated the inaccuracy of the view sometimes expressed that the colour manufacture was stolen from us by our foreign competitors. The cause of our decadence is mainly the discovery of new colouring matters by foreign chemists. Prof. Meldola's reference to the lot of the few research chemists in any English works will appeal very forcibly to those who have undergone this ordeal. "We were but a handful of light skirmishers against an army of trained legionaries."

Of the lectures and addresses delivered during the war period one may select Lord Moulton's discourse on the manufacture of aniline dyes in England. This discourse deals with the prevailing shortage of dyes, the cause of German supremacy in their manufacture, and the means to be adopted to establish a British dye industry. The formation of a large national company is advocated, a company which is to be co-operative between the producer and consumer.

The compiler of this volume contributes two articles to this discussion of the character of the new company, and insists that "it is foredoomed to failure unless a scientific rather than a purely commercial spirit permeates the management." Similar views are expressed by Prof. Frankland in a very illuminating synopsis of the chemical industries of Germany. "If the proposed undertaking is to succeed, real chemists must be on the directorate, and in a sufficient proportion to give effect to their views." After recounting the history of German chemical industry and illustrating the magnitude of the chief branches of this trade, the lecturer emphasises the difficulties attending the rehabilitation of chemical industries in this country owing to the attitude of the influential classes of the population towards science in general and towards chemical science in particular.

The two concluding chapters are the Presidential Addresses for 1915 to the Institute of Chemistry and to the Chemical Society. In the former of these addresses Prof. Meldola, after referring to the warnings he uttered thirty years ago, pleads for scientific guidance and direct expert assistance in the management of our chemical factories. In the latter address Prof. W. H. Perkin, in discussing the possibility of recovering some of the lost chemical industries, urges a close alliance

between the works and the research laboratories of the universities. He also deals with the prospects of the new dye company, and suggests certain lines along which this enterprise might develop to the best advantage. G. T. M.

SCHOOL MATHEMATICS.

(1) *A First Book of Arithmetic.* By S. Lister. Pp. vii+258. (London: Macmillan and Co., Ltd., 1915.) Price 1*s.* 6*d.*

(2) *Elementary Algebra: First Year Course.* By F. Cajori and L. R. Odell. Pp. vii+206. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 3*s.* net.

(3) *Revision Papers in Algebra.* By W. G. Borchardt. Pp. vi+152+Answers. (London: Messrs. Rivingtons, 1915.) Price 2*s.*

(4) *Tables for Converting Shillings, Pence, and Farthings into Seven Places of Decimals of a Pound; and for the Reconversion of Decimals.* Pp. 6. (London: C. and E. Layton, n.d.) Price 1*s.* net.

(5) *The Rapid Reckoning Chart.* By Dr. E. E. Fournier d'Albe. (London: Educational Supply Association, Ltd.) Price 3*d.* net.

(1) THE decimal fraction is the central point of modern arithmetic. This is realised by Mr. Lister, who begins his book with the graphical abacus. The explanation of its use for integers leads up very simply to its use for decimal fractions. All other aids are also pressed into the service, such as the use of metric measurements, expression of a decimal in words as so many tenths and hundredths, and the actual measurement of lengths by a suitably divided ruler. It is, in fact, difficult to see how the dullest boy can fail to grasp the idea as presented by Mr. Lister.

We are pleased to see a book on arithmetic compressed within little more than 200 pages, but rather regret the suggestion contained in the title "A First Book of Arithmetic" that further books on the subject must be used. The title may, however, be nothing more than a concession to custom. Similar concessions are seen in the very elaborate tables of money and measures and in the conversion between different systems of measures. Such concessions are not only pardonable; they are necessary if a book is to succeed. We wish the book all success; it is the best we have seen for a long time.

(2) This book on elementary algebra is pleasing in several ways. It contains historical notes on the development of algebraic notation, including the remarkably clever notation in use among the Egyptians nearly four thousand years ago. There are also portraits of famous mathematicians, with historical notes. The type is pleasant to the eye and eminently legible, and the general get up of the book attains the usual high American standard. Graphs are suitably introduced by a temperature curve and a graph of the price of coal; and the treatment of the multiplication of negative quantities is the best we have seen. Yet, when we come to the essence of an algebra, the problem, we find all the old unnatural riddles and never a hint of a problem that is real or connected with daily life; and this in a book to which a famous American professor lends his name. When we consider the advance that has been made in England we are tempted to thank God that we are not as other nations are, and to derive more pleasure in this way than from all the merits of the book.

(3) With the ink upon our pen still wet from our pharisaical boast, we turn to the "Revision Papers in Algebra" and find ourselves liable to the question, "Wherein is this book better than the other?" It is true that this book also contains no natural problems. The natural problem belongs chiefly to the beginnings of the subject, and the student who carries his studies on to indices, surds, binomial theorems, and manipulation must not expect them. The questions before us are fully as good as he has any right to expect. His proper course is to study the calculus instead, or, if he is too weak a mathematician for that, to drop the subject of mathematics. Meantime examiners require this stuff, schools teach it, the pupil must know it, and Mr. Borchardt meets their needs admirably.

(4) The calculating machine arrived some time ago, and some of the results of its arrival begin to emerge. The imperial system of weights and measures does not fit the calculating machine. The machine will not (without assistance) tell you the price of 3 tons 7 cwt. 30 lb. of copper at 60*l.* 17*s.* 4*d.* a ton. So far as pure money calculations are concerned, the necessary assistance is provided by the tables we have before us for expressing any sum of money as the decimal of a pound sterling and *vice versa,* an excellent and well-printed table of four pages. The sum of money prepared by this table is put into the machine, and the result provided by the machine is restored by the table to its usual form. In some happy future we shall decimalise our money once for all by Act of Parliament. Until then these tables by Messrs. Layton have great value as a labour-saving device.

(5) Dr. Fournier d'Albe's ingenious chart is a graphical computer which will perform various operations up to the extraction of the cube root.

It gives the result of the operation within 1 per per cent., a serviceable degree of accuracy. If it is as successful as it deserves to be, perhaps in a new edition the publishers will consider whether a somewhat larger scale is possible, and whether the instructions can be made visible at the same time as the chart. D. M.

THE NORTHERN BANTU.

The Northern Bantu: an Account of some Central African Tribes of the Uganda Protectorate. By the Rev. J. Roscoe. Pp. xii+305. (Cambridge: At the University Press, 1915.) Price 12*s.* 6*d.* net.

MR. ROSCOE is too well known as an ethnologist to require any introduction to the readers of NATURE, who if they are studying the Negro people of Africa will read his new book as eagerly as its predecessors, or those admirable articles from his pen published in the Journal of the Royal Anthropological Institute.

The book under review deals with the physical appearance, manners, customs, beliefs, numbers, and to some extent birth-rate, of the following (more or less) Bantu tribes of the Uganda Protectorate—the Banyoro, Ankole, Bakene, Basoga, and Teso. The Teso are Nilotic in speech, and their inclusion in a review of the Bantu-speaking peoples of eastern Equatorial Africa is only a matter of propinquity.

According to Mr. Roscoe, the Bantu area of the Uganda Protectorate must be considerably extended beyond what was accorded to it in previous conceptions. He writes of the *Bakene* as a most interesting Bantu tribe in the very centre of the Uganda Protectorate, dwelling in floating huts on the Mpologoma River, on Lake Kioga, and on Lake Salisbury. He also adds, "I believe, on Lake Rudolf." He does not give us any reference for this last suggestion, which, if well confirmed, would be most interesting, as it would give us the farthest north known of any Bantu or semi-Bantu tribe in eastern Equatorial Africa. Oskar Neumann, who explored these regions between Uganda and Abyssinia about 1898–99, contended that he had traced the Bantu "type" as far north as southern Galaland (the Omo River basin, etc.). Presumably he meant "physical type," and so far as the Bantu have any generalised physical type (though it is more and more difficult to attribute such to them), it is certainly to be met with in the country of Karamojo west of Lake Rudolf. Moreover, not a few place-names and tribal names in that region suggest the previous existence of Bantu-speaking people before a succession of conquests and colonisations by the Nilotes. Mr. Roscoe says that the Bakene of Lake Kioga are allied to the Basoga, and speak a language or a dialect very similar to Lusoga. Now Lusoga is so close to Luganda that it cannot be accorded more than a dialectal difference. Consequently, if his deductions regarding the Bakene (not supported, however, by any vocabulary) are correct, they are in common with the Basoga and the Basese, outlying clans of the original Baganda nation.

Mr. Roscoe attributes to the Bagesu of western Mount Elgon the practice of eating a portion of the corpses of their dead and throwing the rest to the wild beasts. He rightly alludes to the very "Negro" appearance of the Bagesu and their low status in culture, and remarks on this as being so extraordinary when they are surrounded by both Bantu and Nilote people of handsome physical development and rather remarkable advance in native civilisation. I noted the same fact in my "Uganda Protectorate," and gave therein photographs of Bagesu types to illustrate their physical resemblance to the Forest Negroes and the Congo Pigmies. But my own visit to their country, together with indications given by Mr. C. W. Hobley, revealed the interesting fact that the Bagesu speech may be cited as perhaps the most archaic form of Bantu language. It is one with very elaborate prefixes and pre-prefixes, and is a highly developed speech, probably imposed on these forest savages at a comparatively ancient date by the first Bantu invaders of eastern Equatorial Africa, just as the Congo Pigmies and Forest Negroes of Central Africa now speak for the most part Bantu tongues or languages imposed on them by the Sudanic negroes and negroids.

Unfortunately, the photographs specially taken by Mr. Roscoe for the illustration of this work failed to materialise, owing to the breakdown of his apparatus, and although the book contains a number of interesting illustrations, they are not always apposite to the author's descriptions. Nevertheless, some of these are of great interest, especially that of the King of Bunyoro wearing the special hat for the "secret court."

This last book by Mr. Roscoe will confirm many in the impression that much indirect and ancient Egyptian influence has penetrated to the negroes of northern Equatorial Africa, especially the Bantu, and has been the foundation of most of their religious beliefs and customs. It would almost seem as if from this and that deduction there had been a former continuous tribe to tribe

intercourse between the southern frontiers of the Egyptian empire and the regions bordering Mount Elgon and the division of the Niles, and that some subsequent invasion of the eastern Sudan by the Nilotic Negroes acted more or less completely as a barrier for any further penetration of the white man's ideas from the direction of Egypt and Abyssinia.

H. H. JOHNSTON.

OUR BOOKSHELF.

Quantitative Laws in Biological Chemistry. By Dr. S. Arrhenius. Pp. xi+164. (London: G. Bell and Sons, Ltd., 1915.) Price 6*s.* net.

UNTIL recently, elementary Greek was considered a necessary part of medical education, though it was scarcely possible to justify its inclusion on the ground of utility. Higher mathematics may well take its place, for it becomes increasingly plain that a real working knowledge of it will soon be indispensable for the student of biology or medicine, whether he is content to follow modern developments or aspires to aid its progress. The present work, Arrhenius's latest contribution to the science, is convincing proof of this tendency.

The substances concerned in biochemical reactions are frequently present in such minute quantity, and associated with large amounts of other organic substances, that the older chemical methods are of little use, and recourse must be had to the newer methods of physical chemistry. How this may be done, and the nature of the results, are all to be found in this important book.

Among the subjects dealt with are enzymes, toxins, antibodies, specificity, digestion and resorption, and immunity. Detailed criticism is out of the question, but attention may be directed to the discussions on researches "in vivo" and "in vitro" (p. 84); on relationship, or, literally, consanguinity; and on the "poison spectra" of Ehrlich and the supposed plurality of toxins (p. 118). For example, by applying to the neutralisation of boric acid by ammonia the same reasoning which led Ehrlich and Sachs to divide diphtheria toxin into ten different partial-poisons, Arrhenius found that ammonia must contain six partial-poisons; these conclusions are shown to be due to the errors of observation.

In view of the large number of valuable data and results brought together in the book, the index might with advantage have been a little fuller. W. W. T.

The "Wellcome" Photographic Exposure Record and Diary, 1916. Pp. 257. (London: Burroughs Wellcome and Co.) Price 1*s.*

THIS is a handy pocket-book with pencil; it contains a diary of useful though small dimensions, ruled pages with columns suitably headed for recording the details of negatives and prints made during the year, an exposure calculator with tables suitable for all possible conditions, formulæ with concise instructions for a very considerable number of photographic operations, and other information of the kind that amateur photographers are most likely to need. The formulæ are, of course, given in terms of the firm's tabloids. The weight of the ingredient in each of these is given in many cases. There does not appear to be any good reason why there should be any exception to this, and then photographers would be able to take the very fullest advantage, intelligently, of the convenience of the tabloid system. The three photographs of war subjects, and the one taken on Sir Douglas Mawson's Australasian Antarctic Expedition, are excellently reproduced.

Hazell's Annual for the Year 1916. Edited by Dr. T. A. Ingram. Pp. lxxii+623. (London: Hazell, Watson and Viney, Ltd.) Price 3*s.* 6*d.* net.

A NOTABLE characteristic of the thirty-first issue of this popular annual book of reference is the detailed list of more than a thousand learned societies and institutions which it contains. Though as far as possible the editor has retained the usual contents of the volume, it is very naturally this year a war edition. Not only has a large amount of space been absorbed by the events of the great struggle, but also many of the more general articles have been written from the same point of view. The annual is as useful and comprehensive as ever, and the editor may be congratulated on the way in which he has surmounted the special difficulties of compilation at the present time.

Scientific Ideas of To-day. A Popular Account of the Nature of Matter, Electricity, Light, Heat, etc., in Non-technical Language. By C. R. Gibson. Fifth edition. Pp. 344. (London: Seeley, Service and Co., Ltd., 1916.) Price 5*s.* net.

THE first edition of Mr. Gibson's popular book was reviewed at length in our issue of April 15, 1909 (vol. lxxx., p. 181), and it will be sufficient to say of the present edition that it has been revised and brought up to date. Recent advances in the knowledge of the constitution of matter and the nature of X-rays have been incorporated, and the electron theory is given due importance.

The Scientists' Reference Book and Diary, 1916. (Manchester: James Woolley, Sons and Co., Ltd.) Price 2*s.*

THE reference book and diary are separate publications enclosed in an attractive leather case for carrying in the pocket. The former includes the numerical and other data which the worker in science likes to have readily available, and the latter, in addition to the usual diary, has abundance of space for memoranda.

Aerodynamics

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.]*

Researches in Aeronautical Mathematics.

THE intimation in the columns of NATURE that I should be glad to receive offers of collaboration in the solution of problems in the applied mathematics of aeroplanes has, as I am pleased to state, met with a reply from Mr. Sely Brodetsky, lecturer in the University of Bristol.

Mr. Brodetsky has now definitely taken over the problem of the two-dimensional motion of a lamina in a vertical plane, with special reference to cases in which the equations of motion can be integrated either by methods of approximation or otherwise. The only cases previously studied appear to be Lanchester's "fugoid" and allied types of motion, and the small oscillations about a steady state of motion in which the plane of the lamina makes a small angle with the direction of flight. Other possible types of motion are those in which the lamina turns over and over in its descent, or performs oscillations about a state of steady descent in a vertical line with the plane of the lamina horizontal.

As these types of motion may occur when an aeroplane becomes uncontrollable, it should be evident that such investigations offer a considerable prospect of leading to results of practical utility.

Various empirical forms have been proposed for the resultant pressure on a plane lamina or the co-ordinate of its centre of pressure when expressed as functions of the angle of attack. Among the former, Duchemin's formula is probably the best known. It is convenient for purposes of comparison to choose the coefficients and constants so as to make the pressure unity when the angle of attack is 90°. Under these conditions Duchemin's expression becomes

$$\frac{2\sin\alpha}{1+\sin^2\alpha}$$

The use of Fourier's series affords a convenient method of standardising and comparing such expressions, and the results of experiment. Duchemin's formula is easily expanded by means of De Moivre's theorem in the form:

$$(4-2\sqrt{2})(\sin\alpha+r\sin 3\alpha+r^2\sin 5\alpha+\ldots.),$$

where $r=3-2\sqrt{2}$.

Mr. T. G. Creak, of Llanberis, has evaluated the coefficient in this series as well as in a number of formulæ proposed by other writers, and Mr. W. E. H. Berwick has assisted. The investigation is now being continued by Mr. Caradog Williams, a post-graduate student in my department, who is applying Fourier series to the results of experiment, and, in particular, to the tabulated results given by M. G. Eiffel in his "Resistance of the Air and Aviation."

The results, which are extremely interesting, indicate that the method is advantageous in several respects; in particular, the Fourier expansions, while being of uniform *standard* types, are sufficiently *elastic* to be applicable to the most varied forms of plane and curved surfaces. In the case of plane surfaces we have the following results:—

(1) The resultant pressure can be expanded as a sum of sines of odd multiples of the angle of attack, the expansion holding good from 0° to 360°. The series usually converge according to the "inverse square" law. The first coefficient usually lies between 1·0 and 1·25, and the second between 0 and 0·25. The extreme limits, 1·25 and 0·25, represent the values according to Soreau's formula, and are rather in excess of those deduced from most of Eiffel's experiments.

(2) For small angles of attack the sine series may sometimes be inconvenient, and it is preferable to express the result as the product of $\sin\alpha$ into a series of cosines of even multiples of α. From this cosine series the series of odd sines is immediately deducible, but the converse is not possible until the first (or constant) term of the cosine series has been evaluated. In future calculations it may, therefore, be better to start with the cosine series.

(3) The series for the lift and drift are immediately deducible.

(4) The distance of the centre of pressure from the centre of area is given by a series of odd cosines, and the moment of the resultant thrust about the centre of area by a series of even sines.

Mr. Williams and I are also employing the method of least squares to obtain expansions in the case of curved surfaces when the results are only required for a limited range of tabulated values, and as the method of least squares leads to Fourier's expansion as a particular case, whatever be the number of terms that it is desired to retain, comparison of results should be easy.

While it may be sufficient for many purposes to adopt a formula of the type $A_1\sin\alpha+A_3\sin 3\alpha$ for the resultant thrust, the first two terms are not sufficient to give the correct position of the maximum in Eiffel and Denes's results for square plates. In very few cases is there any advantage in going beyond $\sin 5\alpha$.

The method is obviously applicable to an aeroplane considered as a whole, and it thus opens up a number of problems on longitudinal motion, equilibrium, and stability. In particular the conditions may be studied under which there is only one unique possible state of steady motion. This condition does not lead necessarily to the evolution of a non-capsizable aeroplane analogous to the non-capsizable lifeboat, as equilibrium can still be broken by the types of looping motion mentioned earlier.

The programme of work does not stop anywhere near this point. The most important task before us is to apply the method of initial motions to investigate the effect of atmospheric disturbances—in other words, suddent gusts of wind. For this problem the Fourier method will be very useful in dealing with longitudinal disturbances, but it is not so easy to decide on a suitable expansion when lateral changes of wind velocity are taken into account.

The motion of a kite was investigated by Prof. Bose in the Bulletin of the Calcutta Mathematical Society, ii., 1; unfortunately, however, an examination of the paper by Mr. W. E. H. Berwick and myself reveals a number of errors in the equations, and the form in which the tension of the string is taken into account renders the solution totally inapplicable to any system resembling an ordinary kite. The only thing possible in the circumstances was again to formulate the correct equations of motion, which appear to be rather complicated, entirely *de novo*, in the hope that Prof. Bose or some other mathematician may be able to do the rest. It would be an advantage if two workers could attack the problem independently. It is not encouraging to find that a problem which was supposed to be relegated to the shelf as having been solved requires to be reinvestigated.

The effects of propellers on the equilibrium and stability of aeroplanes require careful classification.

In addition to the constant torque of the propeller, and the gyrostatic effects due to its rotatory inertia, the propeller introduces a number of additional terms into the resistance derivatives, thus mixing up the longitudinal and lateral oscillations. I propose that a theoretical basis of comparison should be worked out for these coefficients by treating the propeller blades as "narrow planes gliding at small angles" in a medium the resistance of which follows the sine law. Whatever objections may be raised to this assumption, it will at any rate lead to some definite conclusions with which results of experiment can be compared.

I have for a long time past expressed the hope that it may be found possible to develop the tandem propeller with blades rotating in opposite directions, the rear propeller having the higher pitch.

Practical experts state that the system has proved a failure. It would be interesting, however, to learn whether this is because there is no perceptible gain of efficiency, or whether there is really a serious loss of efficiency. To get rid of the unsymmetrical action of the propeller would be worth some sacrifice of efficiency.

Mr. R. Jones, late of this college, who is now working with Mr. Bairstow in the National Physical Laboratory, has just contributed a paper to the Royal Society on motion of a stream of finite breadth past a body (see NATURE for November 11, p. 304).

It will thus be seen that while we are making a fresh start in the study of the rigid dynamics of aeroplane motions, more recruits are needed if we are to arrive at anything approaching a clear understanding of the subject before the end of the war. In the meantime every aeroplane is to be regarded as a collection of unsolved mathematical problems; and it would have been quite easy for these problems to be solved years ago, before the first aeroplane flew. I have seen no reference to aeroplanes in connection with Section A of the British Association; and this in war-time! It would be quite impossible for me in the circumstances to divert my attention to the practical aspects of aviation, for to do so would only add to the collection of unsolved problems. It therefore became necessary for me to resign from the committee of the association Mr. Blin Desbleds is endeavouring to form, and it is further necessary for me to disclaim any connection with a Government committee such as has been recently announced in certain sections of the Press.

G. H. BRYAN.

University College of North Wales, Bangor.

Belated Migrants.

IT may be of interest to the ornithological readers of NATURE if I place on record that on the morning of December 27, just as the gale of the previous night was abating, and in a gleam of sunshine that broke through for nearly half an hour about 10.30, I observed against the blue sky a flock of birds flying over Wilton Park (on which my house gives) with a very herundine flight. They were excitedly disporting in the wind, wheeling and gyrating, just as they do so often prior to their autumn migration. At first I thought they must be starlings; but on their coming close overhead the white in their plumage showed them to be martins. There were from a dozen to a score of them, and they were moving in a northerly direction; but as I was starting to catch a train, I could not, to my regret, watch them longer, and that bearing may not be the course they afterwards pursued. Whence had they come, and whither were they bound?

It may be perhaps also worth mentioning that for the past fortnight our hedgerows here and the Wilton and Burnham woods have been quite resonant with the spring songs of many species of birds. The thrush and the blackbird have been especially vociferous for more than a week, each day adding to the melodiousness of their song. The latter have been engaged, often half a dozen at a time, in quite spectacular love-tournaments in my garden—where the snowdrops are already some time in flower—for nearly three weeks past. Now and again a soaring lark also fills the air with his melody. May such early harbingers of spring presage a new year "happy and victorious"!

HENRY O. FORBES.

Redcliffe, Beaconsfield, Bucks, January 1.

The Popularisation of Science.

I HAVE read with interest the several articles you have recently published on the position of science in England, and would like to be allowed to make a few remarks on the subject.

It is scarcely surprising that scientific knowledge is so little disseminated in this country considering the difficulties which hinder its acquisition. If science is to become widespread, it seems to me essential that it should be democratic both in its higher and its lower branches. In England, however, science may be said to be aristocratic. Scientific societies demand more or less high subscriptions. Public lectures on science are rarely free. In London an institution exists where advanced lectures are given, but the subscription to which is considerable, and to become members of which people have actually to be recommended—recommended to be allowed to learn!

In France matters are different. The membership of scientific societies is moderate, and higher scientific education is provided *gratuitously* by the State at the Collège de France, the Sorbonne, and elsewhere. There are many instances in France of men devoting themselves to research from purely intellectual motives, and in most classes in that country the scientific spirit is displayed.

F. CARREL.

Bath, December 16.

THE EXPORT OF FEEDING STUFFS AND FERTILISERS.

RECENT correspondence in the *Times* has revealed a certain amount of uneasiness at the export from this country of fertilisers, linseed cake and other feeding stuffs, which go to neutral countries, but, it is suggested, do not stop there, as the quantities are in excess of normal consumption. It is urged on one hand that the proper maintenance of the balance of trade requires the export of as many commodities as possible, and, on the other, that any fertilisers and feeding stuffs which found their way to enemy countries would obviously prove extremely valuable to them.

The fertiliser mainly concerned is sulphate of ammonia. About 400,000 tons of this are normally produced here each year, of which 300,000 are exported, Japan taking about 100,000 tons, Spain 60,000, the Dutch East Indies and the United States each about 40,000 tons, and so on. Holland only takes a little: no more than 3000 to 3500 tons per annum. At the present time foreign shipments are of course only allowed under licence, but it is stated on the authority of a trade publi-

cation that licences are now granted to Holland to the extent of 5000 tons per month, that is, seventeen to twenty times the usual quantity. As Great Britain is the chief exporting country, supplying both France and Germany (in addition to their own production), it cannot be urged that Holland is cut off from its usual sources of supply, and one may well ask what becomes of the difference between 250 tons of normal monthly imports and the 5000 tons that will be imported monthly if the present licence is correctly described and continues in force.

The obvious suggestion is that it finds its way to Germany. But one ought not too hastily to accept it. Five thousand tons of sulphate of ammonia per month is not a small quantity that could be smuggled over a frontier unknown to the authorities, and the licence would presumably be revoked if any extensive smuggling were discovered. It is at least possible that the fertiliser is wanted for trans-shipment. The Dutch East Indies take very considerable amounts of sulphate of ammonia for fertilising the sugar canes: in 1914 56,000 tons were imported for the purpose. Here, of course, there is no question of enemy benefit. Further, the United States only received one-third of their usual amount during the first six months of 1915, and Japan only about one-fourteenth. There is therefore a considerable margin to be made up.

In the December number of the *Journal of the Board of Agriculture* a very straightforward account is given of the work done by the Special Enquiries Branch of the Board during the first twelve months of the war. It is stated that the Board draws up systematic monthly reports showing the supplies of agricultural commodities, and that it acts as adviser to the War Trade Department, which gives to traders the necessary licences to export. The Board has therefore the facts in its possession, and no one can reasonably doubt that it looks after the interests of the farmer. It is pointed out in the article that prohibition of export is not altogether simple: apart from the question of balance of trade it was necessary to enter into mutual arrangements with certain neutral countries who supplied us with butter, margarine, bacon, eggs, etc., to maintain normal conditions so far as possible; we sending out fertilisers and feeding stuffs, and they returning the usual human foods.

This consideration obviously cannot be neglected. The Board has, however, laid down the general rule that no licences to export fertilisers and feeding stuffs should be given until the British farmers' requirements are satisfied, and to this end it made an arrangement last autumn with the dealers in sulphate of ammonia whereby farmers were able to buy at 14*l.* 10*s.* per ton until the end of December. Many availed themselves of the opportunity. The arrangement has now terminated, and the dealers are already asking 16*l.* 15*s.* per ton. This, of course, is not proof that the British farmer has not enough, but simply that prices abroad are higher than in this country. If farmers have to pay the present high price they have only themselves to blame for neglecting to secure their stocks while they had the chance.

The whole question turns on the amount the British farmer requires. Not long ago the Board issued a circular suggesting that farmers should top-dress their wheat with about 2 cwt. sulphate of ammonia. There are in the country two million acres under wheat, and if all this land received the dressing 200,000 tons would be required—probably most of our present production available for export. But the whole of the land could not receive 2 cwt. per acre, nor did the Board suggest it. On the other hand, the hay land could very well receive more sulphate of ammonia than it now has. Further, the restriction in the supply of nitrate of soda is bound to increase the demand for sulphate of ammonia for other crops. It is certainly not easy to decide exactly how much the British farmer does want or will use, but as the Board is in close touch with the county authorities it ought to have no difficulty in knowing the position at any time.

There is another aspect of the matter that ought not to be overlooked. Ammonia is convertible into nitric acid, and in Germany the process is actually carried out. We may hear of a similar development in this country, and in that case the margin for export would be lowered still further.

Superphosphate and basic slag are both exported from this country in normal times, and the export is still allowed under licence. Probably many farmers would be prepared to use more than they have in the past, but the universal complaint is that they cannot get delivery. We are somewhat in the position of the days before railways, when it was often easier to send things abroad than to deliver them in England.

The facts do not justify the assertion of some of the correspondents that the Board has been unmindful of the interests of the farmer. Assuming that steps are taken to prevent leakage to enemy countries, there can be no objection to the export to neutrals of any excess of fertilisers and feeding stuffs over and above the requirements of our own farmers. These are higher than in normal times, though it is difficult to say by how much. Long-period licences for export ought, therefore, not to be allowed, but there seems no objection to the short-period licence.

A greater difficulty is transport. It would be worth inquiring whether fertilisers and feeding stuffs ought not to rank as Government goods on the railway, and have precedence over ordinary commodities. If, in addition, an arrangement were made similar to that with the sulphate of ammonia producers, viz., fixing a price and issuing no licences until home wants are supplied, farmers would be enabled to purchase abundant supplies at reasonable prices. Remembering that 1 lb. of sulphate of ammonia, in suitable conditions, often yields more than 2 lbs. of wheat, the advantages of ample dressings are obvious.

Clay industries

THE CERAMIC INDUSTRIES.[1]

THE intimate relation between the various industries and clay is seldom appreciated. The gas industries, coking plants, iron, steel, and non-ferrous metallurgy; glass manufacture; and the ceramic industries are all to a large extent dependent on good refractory materials. It is therefore obvious that a manufacturing country must devote much attention to its clays, for progress in these industries is largely dependent on improved refractories. In the pre-war days, consumers were pushing the firebrick manufacturers for improved methods of manufacture to meet the more severe fire-tests imposed by modern conditions. It was the custom to vaunt the German methods of manufacture, and to condemn the benighted British. There is much truth in the old firebrick manufacturer's contention that God has given each manufacturer particular clay-beds, and that no improvements in methods of manufacture will make a bad clay into a good one. As a matter of fact, there appears as much difference in the character of clays from different beds as there is between different individuals; and to get each clay to do its work most efficiently it must be humoured in manufacture and in use. If the firebrick be not in a suitable environment, it will break down. Experience is constantly bringing to light cases where good firebricks do satisfactory work in one furnace, and fail in another, where, at first sight, the conditions appear similar, thus showing that firebricks are sometimes very sensitive to local conditions.

Satisfactory progress can be made only by the co-operation of maker and user. The experience of both must be pooled for the common good. We can then find what clays are best adapted for particular purposes, and the manufacturer will have a more clear and definite idea in what directions he can best modify his methods to make his clays do their best work. This gigantic task has been undertaken from the point of view of the gas engineers under the energetic lead of Mr. S. J. Bywater, and slow progress has been made in certain directions. To hasten the final victory, the Geological Survey can help very materially. We want to know the specific character of the different clay beds in the country, and a host of other questions which can best be answered on the geological side. There have been a score of elaborate reports on the clay deposits of different parts of the United States, and half-a-dozen likewise for Canada. Several of these have the character of pot-boilers, and cannot be of much practical use; a few photographs of clay-banks, a few diagrams from the machinery catalogues, and a few clay analyses do not fulfil the required purpose. In England we have lagged far behind even this. We therefore welcome with pleasure the appearance of the work on "China Clay and Cornish Stone" by Mr. J. Allen Howe, curator of the Jermyn Street Museum (1). Is it too much to hope that this work is the forerunner of a series dealing with the whole of the different types of clay in our country? This particular memoir is of most use to the pottery industry, since the materials here discussed have some special qualities which are not required from fire clays *per se*, and which give the china clays a special commercial value. The mere fact that the pamphlet has appeared is a hopeful sign. It has long been the plaint of the clay industries that a great deal of public money has been spent year by year to publish a pile of Memoirs of the Geological Survey of the United Kingdom. Of course, pure geology is exceedingly important and necessary, but why the applications should have been virtually neglected is not always clear.

In the introduction to his brochure, Mr. Howe makes a contribution towards rectifying the general muddle as to the precise meaning of the terms "china clay" and "kaolin"; he then gives a general description of the methods of extracting china clay practised in the south-west of England; then follows a general sketch of the distribution of china clay in various parts of the world. There are also discussions on Cornish or China stone; on the uses of these materials; and on the origin of china clay. There is a review of some recent work on the nature of kaolinite and related minerals. This is followed by a collection of analyses, physical tests, statistics, and a bibliography. Mr. Allan B. Dick contributes an exceptionally valuable appendix on the identification of transparent mineral grains under the microscope.

There are some very useful and trustworthy data in the chapter on analyses and physical tests. These are mixed with a lot of old and inaccurate work which possibly might have been omitted without the loss being felt. Perhaps, however, there is something in the argument that bad data are better than no data at all. The table of exportation of china clay to foreign countries recalls a scandalous anomaly. We know that before the war several factories on the Continent were purchasing English china clay delivered on the works at a lower price than that paid by the Staffordshire potters. It appears that in 1913 Germany purchased more than 70,000 tons at about £80,000; this is interesting in view of the investigations recently made at Charlottenburg with the patriotic object of displacing English china clays by German clays *in Deutschland*.

In "A Study of Atterberg's Method of Measuring Plasticity" (2) Mr. C. S. Kinnison compares the results made by Atterberg's method with those based on wet to dry contraction of clays, and on the water of plasticity method. The results are not very promising. This is not surprising. In my opinion, plasticity is a mechanical property, the magnitude of which is primarily estimated by the potter's thumb, and unless the proposed methods measure approximately the same mechanical property they do not measure plasticity at all, but rather some other quality of clay.

[1] (1) "A Handbook to the Collection of Kaolin, China Clay, and China Stone in the Museum of Practical Geology." By J. Allen Howe, Curator. With an appendix by Allan B. Dick. (London, 1914.)
(2) "A Study of the Atterberg Plasticity Method." By C. S. Kinnison. No. 46. Technological Papers of the Bureau of Standards. (Washington, 1915.)
(3) "Preliminary Report on the Clay and Shale Deposits of the Province of Quebec." By J. Keele. Memoir 64 of the Canada Geological Survey. (Ottawa, 1915.)

The report by Mr. Keele on the clays of Quebec (3) shows that Canada recognises the importance of a definite knowledge of its clay resources. In the preface Mr. Keele says: "Chemical analyses are of little value to him (*i.e.*, the clay-worker), as practically no information regarding the behaviour of clays can be derived from such analyses." This might be true if the statement refers to *some* clay-workers; but it does not require a Gaboriau's Lecoq to deduce a very great deal of important practical information from the analysis of a clay, information, too, which could be otherwise gleaned only after painful processes of trial and failure. The methods of collecting the so-called practical data are largely those followed in the preparation of numerous other reports published further south. This is good so far as it goes, but we must remember that some of the best of these reports were pioneers in this department of clay literature, and have served a very useful purpose. There are many important properties of clays which the progressive worker ought to know which might advantageously have been included. New knowledge, new requirements. Of course, Mr. Keele's report is mainly of local interest, and without a knowledge of the particular district covered by the memoir it can be said that the present report compares very favourably with the best of those made for other localities.

J. W. MELLOR.

SCIENTIFIC STUDIES OF SWINE FEVER.[1]

THE committee appointed by the Board of Agriculture and Fisheries to inquire into swine fever has issued its final report, which contains conclusions of far-reaching importance, and since the main conclusions are based on the results of experimental investigation carried out on the recommendation of the committee by one of its members, Sir Stewart Stockman, who is also the Chief Veterinary Officer of the Board, the report would appear to portend an early radical change in the campaign against the disease.

The causal agent of swine fever is a living organism which is beyond the range of microscopic visibility, and will pass, with fluid containing it, through the pores of the finest bacterial filter. No method of cultivating it artificially has yet been discovered.

Amongst its conclusions, the committee makes the following statements:—That the manure of pigs suffering from swine fever is infective, and that a period of fourteen days may be regarded as sufficient to bring about the disinfection of infective manure through natural causes; (one member of the committee, however, Prof. Penberthy, considers that the experiments on which the latter view is based are not conclusive, and that further experimentation on the point should be undertaken before being accepted as a basis for administrative measures); that rats are not, as has been suggested, pathological carriers of swine fever, and that all the available evidence suggests that swine fever is not disseminated by external parasites, such as lice and fleas; that while persons, vehicles, and animals may carry infective material mechanically, the evidence leads to the conclusion that all wide dissemination of the disease is due to the movement of infective pigs; that a pig may become infective in three days after contracting infection, and before it has actually exhibited clinical symptoms of the disease, and may remain infective for a considerable period, the extent of which has not been fully ascertained; and that there would appear to be cases in which healthy pigs, which have not been visibly affected by swine fever and on post-mortem examination show no evidence of having suffered from swine fever, yet are infective, and continue to be so for a considerable time.

On the question of serum treatment and vaccination as methods of combating swine fever, the committee reports that the serum of a hyper-immune pig, if injected into other pigs, will protect them for a *short time* against swine fever if they are free from infection at the time of treatment, but it is disappointing in the case of young sucking pigs. It has no curative effect. This short period of immunity can be converted into a prolonged immunity if the pigs treated with serum are allowed to come into contact with infection, *i.e.*, by what may be termed "natural vaccination." "Artificial vaccination" may also be carried out. It consists of the simultaneous application of serum injection with an infection produced by the administration of virus by feeding or by inoculation, but the process is attended by greater risks of producing severe forms of swine fever than "natural vaccination."

The committee is of opinion that the continual prevalence of swine fever appears to be due principally to its highly contagious character and the difficulty of its recognition by the pig owner in its early stages and in its milder forms; and the members consider that the extirpation of the disease is practicable only by such drastic measures of slaughter as would involve a prohibitive outlay, and by such severe restrictions on movement as would be fatal to the industry of pig-keeping. New preventive methods, however, may bring about a condition more favourable to the prospect of eradicating the disease.

Recommendations.—In view of all the evidence laid before them, the committee recommends that the attempt to extirpate the disease by general slaughter should be abandoned for the present, and that the immediate object of future policy should be to reduce the mortality from the disease by the use of protective serum as soon as possible in infected herds. The production of immune herds by "artificial vaccination" should be undertaken under suitable conditions. To control the spread of the disease, isolation of infected premises should be maintained, but restrictions

[1] Final Report of the Departmental Committee appointed by the Board of Agriculture and Fisheries to inquire into Swine Fever. Part iv. Final Report, Minutes of Evidence and Appendix. Cd. 8045. Price 8*d*. Can be obtained direct from Messrs. Wyman and Sons or through any bookseller.

should allow of the introduction of fresh pigs to be treated immediately with serum. The committee is strongly impressed by the possibility of artificial vaccination as a method of combating swine fever. It also recognises the advantages that might accrue from the discovery of a trustworthy diagnostic test for obscure cases, and it therefore recommends that investigation into this and cognate matters should be actively continued.

Sir Stewart Stockman's report of his experimental investigation is published with the committee's final report as an appendix, and it contains most important discoveries, both on the question of spread of the disease and concerning immunisation. His proved conclusions on the various aspects of the disease are very numerous, and so very concise that it is impossible to condense them any further for inclusion here. We may, however, refer particularly to the proved existence of the "carrier." It has long been known that a stallion recovered from influenza may continue to infect mares for a considerable period. Stockman appears to have established the fact that a boar, although apparently healthy, may under similar conditions infect sows with swine fever, and they in turn may pass it on to their young. Such then are some of the difficulties of tracing the spread of the disease, especially in the case of an ultramicroscopic causal agent, and in the absence of any known diagnostic agent for obscure cases.

The report and appendix indicate marked progress in our knowledge of the scourge.

MINERAL PRODUCTS OF INDIA.[1]

WHILST he was director of the Geological Survey of India, Sir Thomas H. Holland instituted a system of quinquennial reviews of the mineral production of India, beginning in 1898, and these reviews have appeared regularly every five years since 1903, practically upon the same lines as originally laid down. Their appearance is always a matter of interest to all students of mineral statistics, whether their interest be mainly scientific or mainly commercial, and the present volume, covering the period 1909 to 1913, contains much matter of importance from both points of view.

The two most important, economically, of the mineral products of India are coal and gold; in the five years ending 1908 the average annual output of gold was valued at 2,266,307*l.*, and that of coal at 2,139,249*l.*, so that the former was the more important, in spite of the fact that the period included the boom year 1908, when the value of the coal output jumped up to more than 3,350,000*l.* In the period now under review the positions of these two items have been reversed, the average value of the coal being 2,969,305*l.* per annum, and that of the gold 2,241,844*l.* It will be noted that the gold output has been practically stationary throughout the whole decade; that of coal showed a drop in 1909 from the boom year 1908, and then a steady increase up to nearly 3,800,000*l.* in 1913, which may be taken as a most satisfactory symptom, and as indicating that the Indian coal trade is now on a firm and stable basis. The output in 1913 had reached a total of 16,208,000 tons, nearly double what it was ten years previously, and of this large total nearly one-third was consumed on the Indian railways, which again is an indication of the prosperous condition of the country as a whole. It is important to note, furthermore, that India has the benefit of cheap fuel, the price at the pit's mouth being only 4*s.* 8*d.*, or but little more than half of what it is in this country.

The accident death-rate for the five years under review shows unfortunately a considerable increase over the previous quinquennial period, namely, 1·38 lives lost per 1000 persons employed as against 0·98 per 1000; even the former figure is, however, lower than the average in Great Britain. On the other hand, the output of coal per person employed (below and above ground) shows a slight improvement, namely, 109·4 tons as against 98·6, this figure being about two-fifths of what it is in the United Kingdom. It must not be forgotten that a considerable amount of British coal is machine-cut, whereas coal-cutting machines make practically no headway in India on account of the relatively cheap native labour. It is interesting to note that two batteries of bye-product coke-ovens have at last been installed on the Giridih coal-field, capable of producing 40,000 tons of coke and 400 tons of sulphate of ammonia annually. It can only be hoped that further installations of such coke-ovens will be made, and that Indian agriculturists will learn to appreciate the value of sulphate of ammonia as a manure.

Amongst other items of interest may be noted the commencement of operations of the Tata Iron and Steel Co. at their Sakchi works, in consequence of which the production of iron ore in India jumped up by about 300,000 tons in 1911. The Barakar Iron Works also have replaced their former somewhat uncertain sources of iron ore supply by mines in the Manbhum and Singhbhum districts, and are now smelting about 96,000 tons of ore per annum.

Lead and silver appear for the first time in the table of mineral production, owing to the successful operations of the Burma Mines, Limited, at the ancient Bawdwin mines; the average annual production has been just about 9,000 tons of lead, carrying 80,000 ounces of silver, for the past five years.

Finally attention may be directed to the fact that various mines of the Salt Range have been found to contain in places a not inconsiderable proportion of potassium; some of the raw materials contain more than 11 per cent. of this element, and although its extraction presents some difficulties, the problem appears to be quite capable of solution. In view of the great demand

[1] "Records of the Geological Survey of India." Vol. xlvi. (1915.) Quinquennial Review of the Mineral Production of India. By Sir Thomas H. Holland and Dr. L. Leigh Fermor. Revised for the Years 1909 to 1913, by Dr. H. H. Hayden, Director, and Dr. L. Leigh Fermor, Superintendent, Geological Survey of India. Pp. 296 and Index xlvi. Published by order of the Indian Government. Calcutta: Office of the Geological Survey of India; London: Messrs. Kegan Paul, Trench, Trübner & Co., 1915. Price two rupees.

that there is for potassium salts, and the urgency of finding fresh sources of supply, it cannot be doubted that this subject will receive all the attention that its importance deserves. It would indeed be fortunate if the needs of the British Empire in this respect could be supplied from our great Indian dependency. H. L.

PROF. H. DEBUS, F.R.S.

BY the death of Dr. Heinrich Debus, which occurred at his residence in Cassel, Hessen, on December 9, we lose almost the last link which connects us with that notable group of men—Herbert Spencer, Darwin, Hooker, Huxley, Tyndall, Williamson, Frankland—who constituted the scientific hierarchy of London in mid-Victorian times. To the younger generation of British chemists, Debus was, probably, personally almost unknown, but up to within a few years ago he was a constant annual visitor to England, and was to be found at his former haunts in the Athenæum and Savile Clubs, or at the tables of such of his old friends as were left to him. But as the years passed the ties which led him to revisit the scenes of his social activities became fewer and fewer until there was scarcely a "kent face" left to him in his clubs or in the tea-room of the Royal Society, and London became nothing more to him than a place of dead friendships and departed memories, and so he ceased to come. A spare man, sharp-featured and clean-shaven, of abstemious habits, regular and methodical in his mode of life, and of a singularly placid and equable disposition, he maintained his mental and physical vigour up to an advanced age, and was able to take his daily walk almost to the last. His mortal illness was quite short, and he passed away peacefully during the night of December 9, in the ninety-second year of his age.

Debus belonged to a school of chemists of which scarcely a representative remains. A reticent man, and particularly uncommunicative concerning his personal affairs, very little is known of his origin or early history beyond that he was the son of Valentine Debus, and was born in Hessen in July, 1824. His earliest instructor in chemistry was Bunsen, who succeeded Wöhler at the Polytechnic School of Cassel in 1836, and where he remained until 1839, when he was appointed Professor Extraordinarius at Marburg. Debus followed him from Cassel and graduated at Marburg in 1848. Here he formed the acquaintance of Kolbe, and gained the friendship of Frankland, a circumstance which materially affected his subsequent career, as it led to his coming to England, and his eventual selection as Professor of Chemistry in the Royal Naval College, Greenwich. In Frankland's slight autobiographical sketch, the publication of which we owe to the pious care of his daughters, we read that Debus established a "record" at Marburg, inasmuch as he was the first in that university to hold the "disputation" in German instead of in Latin. What "wrangling" then meant in a German university may be gathered from the following extract from Frankland's journal, under date November 4, 1848, relative to this event:—

> I heard Debus read his discourse and dispute in the University, after which he was fully invested with the title of Ph.D. The Pro-Rector and six professors were present, most of whom, as well as two doctors whom Debus had brought with him, disputed the following theses:—(1) The allotropic condition of matter depends upon differences in the arrangement of atoms; (2) the ferrocyanide compounds are not to be considered as double salts; (3) the opinion of Ettingshausen as to the cause of electrical phenomena is untenable; (4) the unequal heating of the air and the earth is the immediate cause of the greater part of atmospheric electricity; (5) the organic bases are coupled ammonia compounds; (6) the doctrine of polymeric isomorphism is erroneous.[1] The ceremony of installation lasted above an hour and a half, and at its close Prof. Bunsen delivered an oration on the volcanic phenomena of Iceland.

Frankland, it may be noted in passing, established a further "record" by being the first Englishman to graduate in Marburg; on this occasion the Faculty dispensed with the disputation in the Aula altogether, on the ground, as he says, that being a foreigner, he had not sufficient command of the language, either Latin or German.

Debus's earliest published scientific work, in 1848, was probably inspired by Kolbe, who, after a short sojourn in England, had rejoined Bunsen at Marburg. It consisted of a short paper on the chemistry of madder root, in which the author failed to recognise the nature and mutual relations of alizarin and purpurin; these he termed, respectively, "lizaric acid" and "oxilizaric acid." His next essays were more fortunate, and he published in rapid succession a number of papers on organic sulphur products, and on the oxidation products of alcohol, glycerin, and glycol. His work on glycerinic acid and its salts, on glyoxal, and glyoxylic acid, finds its due place in the chemical history of these substances. Among subsequent papers the most noteworthy are "On the Chemical Theory of Gunpowder," "On the Nature of Wackenroder's Solution," and his controversy with the late Sir Henry Roscoe on the origin of Dalton's atomic theory.

Debus came to this country in 1851, and, like his friend Frankland, was at first engaged in school-teaching, first at Queenwood College and then at Clifton. In 1870 he moved to London, and was attached to the medical school of Guy's Hospital as lecturer on chemistry. On the establishment of the Royal Naval College at Greenwich he was appointed Professor of Chemistry, presumably through the action of his friend Hirst, who was made Director of Studies. Here he remained until the age of retirement compelled him to relinquish the duties of his chair, when he gave up his London residence and again settled in Germany.

Debus joined the Chemical Society in 1859, and was a vice-president in 1871–4, but took little share in the management of the society. He was

[1] In the original the titles of the theses are given in German.

elected into the Royal Society in 1861, and served on the Council in 1870–72, and again in 1881–83. He was a well-read, scholarly man, of sound judgment, and a shrewd judge of character. He was never married, but was very fond of children, with whom he was very popular, in spite of certain peculiarities of manner and speech and little affectations of dress—such as a passion for coloured ties—amiable weaknesses which only served to endear him still more strongly to his many friends. He was an excellent teacher, with a quiet dignity of manner, and a subtle appreciation of humour, with a skill in parrying its shafts, which effectively checked the efforts of the potential Ben Allens and Bob Sawyers at Guy's, or the too exuberant spirits of the young lieutenants of H.M.S. *President* at Greenwich. He served for three periods—in all fifteen years—as an examiner in chemistry of the University of London in the old Burlington Gardens days. His sympathy with young men, and his quick discernment of character and merit, together with his experience as a teacher and his wide knowledge of his subject, were excellent qualifications for the position, and he enjoyed the fullest confidence of his colleagues at the famous round-table in the old university buildings. T. E. T.

NOTES.

WE notice the names of three fellows of the Royal Society, all of whom are engaged in Government departments, in the list of New Year honours, namely, Dr. Lazarus Fletcher, director of the Natural History Departments of the British Museum, who has been knighted; Col. H. C. L. Holden, assistant director of supplies and transport, War Office, who has been promoted to the rank of K.C.B.; and Sir W. Watson Cheyne, who has received the honour of K.C.M.G. We do not recognise in the list any names of men specifically selected for honours on account of their productive work in scientific fields, but the following may be appropriately recorded here because of their association with such work:—*Knights*: Dr. Adam Smith, principal and vice-chancellor of Aberdeen University; Dr. G. A. Berry, honorary surgeon-oculist to the King in Scotland, and formerly president of the Royal College of Surgeons, Edinburgh; Dr. T. W. Parkinson, author of works on cancer and tumour; Mr. M. Rees, laryngologist to the King's Household and to Queen Alexandra. *K.C.M.G.*: Sir James Porter, honorary physician to the King. *K.C.V.O.*: Sir A. A. Bowlby, surgeon in ordinary to the King. *C.M.G.*: Dr. J. Cadman, professor of mining in the University of Birmingham. *C.B.*: Col. C. P. Martel, superintendent, Royal Gun and Carriage Factory, Woolwich Arsenal; Mr. A. W. J. MacFadden, Chief Inspector of Foods, Local Government Board.

IN reply to questions asked by Mr. Lynch in the House of Commons on January 4, Mr. Asquith said that every endeavour continues to be made to organise and utilise all the available scientific ability of the country in the most efficient way with the view of coping with problems introduced by the war. The activities of the scientific committees have been by no means limited to criticism and advice with regard to suggestions and inventions sent in from outside. Mr. Asquith also said that a body of scientific workers is definitely charged with the study of actual war conditions, that is, to examine, devise, or invent appliances which may be helpful to the Allies in the field.

THE Government of British Columbia has presented to the Royal Botanic Gardens, Kew, a magnificent spar of Douglas fir to replace the old flagstaff which was taken down in 1913 owing to decay. The suggestion to present a really fine specimen of a Douglas spar was made by Mr. J. H. Turner, the late Agent-General for British Columbia, and was readily taken up by the Premier and the Government of British Columbia. This suggestion, made in the autumn of 1913, has now definitely materialised, and the spar, which was loaded on to the R.M.S. *Merionethshire* in August, 1915, arrived in the Thames at the close of last year, and was moored in the river off Kew Gardens on January 3. The spar was logged from the lower mainland coast of British Columbia. The tree selected measured 220 ft. in length, 6 ft. in diameter at the large end, and 18 in. in diameter at the small end. The log was loaded on a logging railway and hauled ten miles to salt water, being taken by a tug to Vancouver. There it was hewn to its final shape, making it 215 ft. in length, 33 in. at the butt, and 12 in. at the top. Its weight is about 18 tons. The spar was brought from British Columbia on the deck of the *Merionethshire*, and its loading was accomplished with some difficulty. Its erection in the Royal Botanic Gardens will be an operation of considerable magnitude.

WE much regret to note the death of Dr. George Oliver, of Riversleigh, Farnham. He was a man of very great ability and extraordinary energy. Although for thirty-five years he was engaged in a very large and exacting practice at Harrogate, he yet found time to make most valuable researches on the circulation of the blood. He was one of the first to take up the question of the pressure of blood in the arteries, and the instrument he invented for the purpose of measuring the arterial tension in man was only surpassed in ingenuity by his arteriometer for measuring the actual diameter of the artery. He also invented an ingenious instrument for measuring the amount of hæmoglobin in the blood. With these instruments he made many important observations, which he embodied in two works, "Blood and Blood Pressure" and "Studies in Blood Pressure," works which were both of scientific interest and practical value in treatment. Along with Sir Edward Schäfer he examined the action of the extract of suprarenal glands and proved it to be simply enormous. This observation is one of fundamental importance in regard to the physiological problem of how the blood pressure in the living body is maintained in equilibrium. Dr. Oliver was a gold medallist of the University of London, and Croonian lecturer in 1896 at the Royal College of Physicians, of which he was a fellow. He established the Oliver-Sharpey lectureship at the Royal College of Physicians in memory of his old teacher, Prof. William Sharpey,

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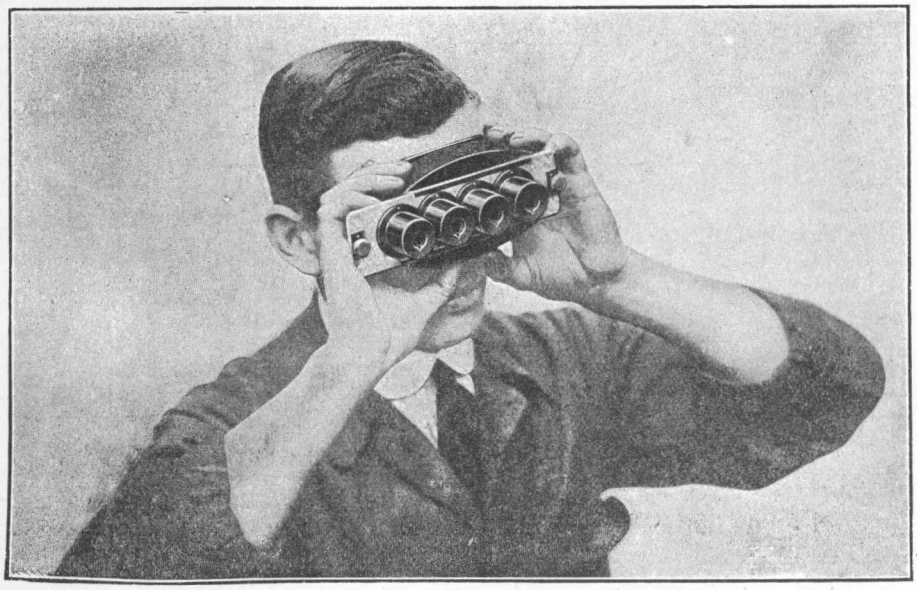

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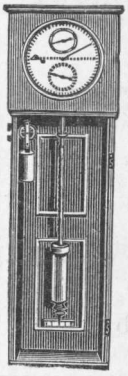

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and he gave a course of these lectures himself in 1904. To those who knew the amount and value of Dr. Oliver's work, it was a constant source of wonder why he was not elected to a fellowship of the Royal Society. His death is a great loss to medicine, for although he was seventy-four years of age he was still active and energetic.

WE announce with regret the death, at Kilmarnock, on December 26, 1915, of Mr. A. D. Darbishire, lecturer on genetics in the University of Edinburgh, and known by his experiments bearing on the laws of heredity, and his book on "Breeding and the Mendelian Discovery." While at Oxford Mr. Darbishire came under the influence of the late Prof. Weldon, and he took up and carried on Prof. Weldon's researches on the inheritance of colour in mice—researches which were designed to test the continuous character of variations in colour, and to prove the untenability of the idea of the clear-cut, sharply distinguishable mutations postulated by Mendel and his followers. A floor case in the Natural History Museum, containing a score of mice of various colours, shows in a most instructive way the practical meaning of the results obtained by him in breeding. After his graduation, Mr. Darbishire became demonstrator of zoology in the University of Manchester, and pursued his investigations there, and gradually he became convinced of the general soundness of the Mendelian position. In 1905 he was appointed demonstrator of zoology in the Royal College of Science (afterwards incorporated in the Imperial College of Science), which post he held until 1911, when he was appointed lecturer on genetics in the zoological department of the University of Edinburgh. Mr. Darbishire endeared himself to all who came into contact with him; his personal charm was really irresistible. During the summer of 1914 he gave a course of lectures on heredity at the Graduate School held biennially in different centres under the auspices of the U.S. Department of Agriculture. Upon reaching home after the outbreak of the war he offered his services as a munitions worker, and spent some months in arduous training for this work. Later, though conscious of the fact that he was really unfit for service in the ranks, he enlisted as a private in the Argyll and Sutherland Highlanders. His appointment to a commission in the Royal Garrison Artillery was published three days after his untimely death, which has deprived British science of a brilliant follower devoted to sound research.

THE death is announced, at Cambridge, Mass., of Mr. C. A. R. Lundin, who won distinction with the firm of Messrs. Alvan Clark and Sons in the construction of many of the largest telescope lenses in the world. He was born in Sweden in 1851, and went to America in 1874, when he became associated with Messrs. Clark. Among the telescope objectives upon which he was engaged are the 30-in. objective for Pulkowa Observatory, the 36-in. lens of the Lick Observatory, the 40-in. lens of the Yerkes Observatory, the 16-in. lens of the University of Cincinnati, and the 18-in. lens of Amherst College. He had also devised and put into operation several important optical tests.

WITH the death last week of Mr. H. A. Taylor, at the age of seventy-four, there has passed away a distinguished pioneer in the development of electrical science, who was chiefly identified with most of the submarine cable enterprises undertaken within the last forty-five years. A mathematician and physicist of a high order, he was associated with the late Latimer Clark in a number of electrical researches in connection with the electromotive force of the standard cell, the effect of temperature on the electrical resistance of gutta-percha, etc. The Clark cell, if carefully used, will remain constant for years, but it polarises quickly, and is generally only used for those tests in which the batteries are tested when they are not sending any current at all, but simply maintaining a potential difference. Taylor was associated with Dr. Muirhead in the development of a system of duplexing submarine cables, which is a modification of the bridge method, and has proved remarkably successful, many important cables, such as those of the Eastern Telegraph Co. and the various Atlantic cables being worked on this plan. The introduction of automatic transmission for cable circuits was also in a large measure due to him.

FROM Würzburg comes the news of the death there on December 2, 1915, of Dr. Fritz Regel, the professor of geography and director of the Geographical Seminar at the University. Regel was born on January 17, 1853; and his first teaching work was done at the Stoy Institute, in Jena. In 1892 he was given the first full chair in geography at the Jena University, where he taught until 1908, when he moved to Würzburg. His skill as a teacher of geography was renowned; no less so was his fame as a writer. He was one of the best authorities on his own native district, Thuringia, about which he wrote the "Landeskunde" (fourth edition in 1913), and a "Handbuch" in three volumes. But he also had more than a passing knowledge of other portions of the globe, as his various books testify—"Kolumbien" (1899), "Die Nord- und die Südpolforschung" (1905), "Der Panamakanal" (1908), his admirable survey of South America (1910), and his description of western, northern, and eastern Europe (1909), the second and first volume respectively of the "Geographisches Handbuch"; and last, but by no means least, his "Landeskunde der Iberischen Halbinsel" (1905), based on travels in Spain.

DR. C. F. HOLDER, who died in October last, was a good type of the open-air naturalist, who combined in a somewhat unusual way a love of sport with a devotion to the cause of wild-life protection. He was born in 1851 in Massachusetts, of Quaker stock, and was devoted to natural history from boyhood. His early work was as a curator in the American Museum of Natural History in New York City, but considerations of health led him in 1885 to Pasadena, in southern California, where he spent the rest of his life, observing and fishing and writing. He was a good citizen of a notably beautiful city, and took a great interest in local educational affairs. Shortly before his death he was appointed honorary professor of zoology in the Throop College, the foundation of the chair being due to a lifelong friend, Dr. George E.

Hale, director of Mount Wilson Observatory. Among Dr. Holder's numerous popular books may be mentioned:—"Living Lights" (1887), a picturesque and concrete account of phosphorescent animals and plants, his interesting lives of Louis Agassiz and of Charles Darwin, besides "Along the Florida Reef" (1892), "Stories of Animal Life" (1900), "Half-Hours with Nature" (1901), "The Log of a Sea Angler," and "Life in the Open in Southern California." He was tireless in his endeavours to infuse into others his own enthusiasm for natural history, to broaden the interests of the sportsman, and to strengthen the hands of Audubon societies and similar leagues which have for their object the conservation of the wild life of both land and sea.

THE *Times* of December 30 publishes the following note from its Huddersfield correspondent:—Good progress is being made in carrying the British Dyes (Limited) scheme into effect. With more than 3000 workmen, the contractors, Messrs. McAlpine, are pushing forward the erection of the works, which will form the main portion of the scheme. The chief hindrances are the scarcity of labour and of raw materials for the manufacture of colours. Exceptionally high rates of wages are being offered for men, from ordinary navvies to skilled artisans and chemical workers. Many hundreds of men drawn from other occupations have become chemical workers and are making more money than ever they earned before. As for raw materials, British Dyes (Limited) are obtaining a preference in regard to supplies, and the output is steadily increasing. While the demand cannot yet be fully met, it is officially stated that within another month the supply will be much more adequate.

THE report of the council of the Scottish Meteorological Society, read at the general meeting of the society on December 21, shows that during the past year the more purely routine work of the society has proceeded much on the usual lines, though difficulties inseparable from war conditions have arisen, and at one or two stations it has been found impossible to continue a full set of observations. At most of the stations in Scotland the work is in the hands of voluntary observers, and the closer connection that now exists between Edinburgh and the Meteorological Office in London has in no way weakened the almost family loyalty that linked the observers to the society. Indeed, the extended publicity now available for trustworthy observations through the medium of the Monthly Weather Report has been greatly appreciated by the observers. During recent years the society has devoted much attention to the encouragement of the observation of rainfall in Scotland, and there are now available in the Journal monthly and annual figures for more than 700 stations. An improvement has taken place in the representation of the upper part of the Spey valley; but there are still large areas in the Highlands and north of Scotland for which no information is available. Prof. R. A. Sampson, Astronomer Royal for Scotland, has been elected president of the society for the ensuing twelve months, and Mr. C. T. R. Wilson, University lecturer in physics, Cambridge, and Dr. A. Crichton Mitchell, Edinburgh, vice-presidents.

WE have received the annual report of Livingstone College for the year 1914–15. We have on several occasions directed attention to the work of this college, which is to give an elementary training in medicine to missionaries. The college as such is closed for the present, as it is being used as a hospital for convalescent wounded soldiers.

A FIRST report of the Special Investigation Committee of the Medical Research Committee upon the incidence of phthisis in relation to occupations has recently been issued, and deals with the boot and shoe industry. The conclusions arrived at are: (1) that phthisis is specially prevalent among workers in the boot and shoe industry, as compared with the general population; (2) the individual worker is predisposed to infection by the sedentary nature of his employment, and possibly by the attitude he adopts at his work; (3) the infection is probably (*a*) increased by the number of infective workers, and (*b*) favoured by want of light, the presence of infected dust, and inadequate ventilation in the workrooms. The measures suggested to diminish the incidence of phthisis among this class of operatives are improvement of lighting, floor cleaning, and ventilation in the factories, and the introduction of periods of rest and exercise for the workers. A modified scheme of sanatorium treatment for the affected is also outlined.

WE commend to our readers the admirable article by Prof. Fraser Harris in the *Scientific Monthly*, October, 1915, on "Edward Jenner and Vaccination." Prof. Fraser Harris gives us a short historical sketch of the earlier ages of smallpox in Europe; the old story, how disease, like trade, "follows the flag"—follows, *pede aequo*, the crescent and the cross. Then an account of the discovery of inoculation: a method of great antiquity, used far and wide among "savages," let alone the Turks, who taught it to Lady Mary Wortley Montagu. Then a careful description of the rise and development of Jenner's work, and a sufficient notice of the objections raised against it. Especially, he answers well the stock objection, that not Jenner but "sanitation" saved us from the scourge of smallpox. Perhaps, in years to come, men of science will discover some method of personal immunity even better than vaccination; some "vaccine" made without the intermediary calf. If or when they do make that discovery, they will make it on the direct lines of the work which Jenner began and Pasteur advanced. In that day, let us hope, the nation will put Jenner's statue back in Trafalgar Square. If there is no room for it, they can move King George IV. to the vacant pedestal in Kensington Gardens.

THE small South American deer known as "Brockets" will furnish some useful data to those who are interested in the study of incipient and variable characters, and the bearing which these have on the evolution of species. This much will be apparent to all who read Mr. J. A. Allen's valuable "Notes on American Deer of the Genus Mazama," in the Bulletin of the American Museum of Natural History, vol. xxxiv. Broadly separable, on the basis of coloration, into two groups, in the matter of their antlers, which are but simple spikes, no

diagnostic characters can be found. These weapons indeed are very variable, even in adults of the same species, and should perhaps be regarded as disintegrating structures, since in both groups they display a marked tendency to malformation. In regard to cranial characters, it is evident that, as the author points out, the relative size and form of the nasals, the size and contour of the antorbital vacuity, the junction or otherwise of the premaxillaries and nasals, and the depth of the lachrymal pit are extremely untrustworthy as diagnostic characters, although they often enter into the diagnoses of species and subspecies.

SOME valuable notes on the fauna and flora of the Vedda country and on the Vedda people, by Mr. F. Lewis, appear in *Spolia Zeylandica* (vol. x., part 37). The area surveyed includes part of the eastern and part of the Uva provinces, and is inhabited to-day by people of mixed origin, mainly Sinhalese and Tamils. Pure Veddas are practically extinct. The survivors of this primitive race exhibit a great reluctance to speak in the Vedda language in the presence of Europeans; nor are they more communicative in regard to the manners and customs of their race. Nevertheless, Mr. Lewis contrived to gain some valuable information when at Selavai, in the Panapa Pattu. From one old man he learned that the Veddas, in the days of their prosperity, were divided into a number of small clans, each of which occupied and hunted over a specific area of country, and had no connection with the others, who lived in separate communities. The women were kept in a state of rigid subjection, married as children, became mothers at fourteen, and passed the prime of life at thirty. These people had no domesticated animals save the dog, and their only weapons were the bow and arrow, the spear, and a small axe or hatchet. At one time, it appears, they were harassed by a pigmy people, the Nittawo, who lived in the country known as Lenama, which extended from Bagura, in the east, to the confines of the Kataragama hills on the west. These diminutive people lived in small troops, and inhabited caves, hollow trees, and the crevices of precipices. In stature they are said scarcely to have exceeded 3 ft. Through fear, or jealousy, they are said to have been exterminated about three or four generations ago by the Veddas themselves.

In the *Annot. Zoolog. Japan,* ix., part 1 (Tokio, 1915), Waro Nakahara describes the Japanese lacewing flies of the subfamily Hemerobiinæ. Of the twenty-two species enumerated, three only are inhabitants also of Europe, and of these, two—*Hemerobius humuli* and *Micromus angulatus*—are also North American.

ABNORMALITIES in the venous system of the frog are more or less familiar to teachers in zoological laboratories. W. E. Collinge gives (*Journ. Anat. and Physiol.*, l., pp. 37–42) some results from the dissection of five hundred specimens, of which twenty-two were in some respect abnormal. Of especial interest are the persistence of the caudal vein, of the right posterior cardinal sinus, and of the anterior abdominal vein's connection with the precavals on one side or both; also the continuity of a renal portal vein with the post-caval.

PROF. NANSEN describes the details of construction of two closing tow-nets in *Publications de Circonstance,* No. 67, issued by the International Council for the Study of the Sea. The first net is the well-known form devised by Prof. Nansen for vertical hauls, which had not previously been described in detail. The second net is a modification of the first, adapted for horizontal towing. A current meter fitted in the mouth of the net is stated to make it possible to measure the volume of water which actually passes through the net.

THE twenty-first volume of the *Rapports et Procès-verbaux des Réunions* of the International Council for the Study of the Sea, recently issued at Copenhagen, contains the administrative reports for the years 1913 and 1914, and its chief interest perhaps lies in the fact that it records the attempt which is being made to keep this international organisation in existence during the period of the European war. The report states that as regards participation for the year 1914–15, all countries except Germany have paid contributions, that for Russia, however, being an overdue contribution for the preceding year. In a letter of January 29, 1915, to the Danish Foreign Office, the German Government has explained its attitude in the following terms :—"Germany will during the war abstain from further co-operation in the work of the international investigations, because the carrying out of an essential part of the problems has been suspended by the present state of matters. Consequently the German delegates will not take part in the voting and resolutions of the organisation as long as war continues. The Imperial Government, however, hope to be able to resume participation when a more quiet time has ensued." As regards the scientific reports contained in the volume, those of importance deal with the investigations on herring fisheries.

MR. L. LANCELOT BURLINGAME has published a series of memoirs on *Araucaria brasiliensis* and on the origin and relationships of the Araucarians in the *Botanical Gazette*, vol. lvii., No. 6, vol. lix., No. 1, and vol. lx., Nos. 1 and 2 (1914–15). His researches embrace a careful study of the ovulate cone and female gametophyte, fertilisation, the development of the embryo and the seed, illustrated by a series of plates of microphotographs. In the two latter papers the various views of Araucarian affinities are reviewed, and the conclusion is arrived at that the Cordaitales are the nearest allies of the Araucarias, since they resemble them more nearly than any other conifers. The transitional conifers of the Mesozic are either Araucarians or Cordaitians, and it is suggested that some are ancestors of Sequoia and Cryptomeria. It is also suggested that the Abietineæ are derived directly from the Cordaitales or from very ancient members of the Araucarineæ.

IN the cutivation of varieties of wheat, mixtures of types sometimes occur on the pure-culture plots, which are often very difficult to explain. In vol. x., part iv., of the Agricultural Journal of India, Mr. D. Milne

shows that whole wheat grains fed to the bullocks working in the wheat fields in the growing season can pass through the animals, germinate, and thus account for some of these contaminations of the pure cultures. Six bullocks were fed on a special diet of whole wheat grains previously soaked for one hour in cold water. A mixture of green oat plants and wheat chaff was also given as fodder during the experiment. All the wheat grains voided by the animals were carefully collected, and at once placed on a bed of sterilised sand for germination tests. A considerable number of wheat grains capable of producing strong plants were taken from the dung of every bullock within 13½ hours from the start of the experiment. On the third day the number of grains passed by one bullock in 24 hours rose to more than 9000. After seven days the diet of whole wheat grains was replaced by whole gram grains, yet for two days after this change large numbers of wheat grains capable of germination continued to pass through the animals. As much as 20·5 per cent. of the grains fed to a single bullock were recovered, germinated, and produced strong healthy plants; the lowest figure from a single bullock was 9·6 per cent. The gram grains fed during the last four days of the experiment also passed through in quantity, apparently undigested, but practically none of these gram grains germinated. The author thinks that the amount of obviously undigested material which came through these bullocks was astonishing, but, in this country at any rate, farmers well know the superior digestibility of crushed or ground grain, so that the investigation suggested on this point would appear to be unnecessary.

FROM an American source (Bull. Seis. Soc. America, vol. v., 1915, pp. 155–9), we learn that several earthquakes were felt during last summer in countries now at war. On June 3 an earthquake occurred at Munich of sufficient violence to wreck some of the instruments in the observatory tower. On June 13 a severe earthquake disturbed the kingdom of Württemberg, being especially strong at Ebingen and Balingen. On August 11, at 10.14 a.m., a shock of unusual severity was felt at Laibach, the well-known seismic centre in the south of Austria. In the same journal, the occurrence is reported of several earthquakes at Avezzano on August 28, of a severe shock at Agualia (fifty-eight miles north-east of Rome) on September 23 at 7.15 p.m., felt also in Rome, and of a strong shock unaccompanied by damage, at Messina, on September 24.

TWO articles by M. Louis Brunet, in the *Revue générale des Sciences* for November 30 and December 15, contain in about twenty pages a very complete and readable summary of the recent work which has been done on the constitution of Röntgen or X-rays, and their application to the determination of the arrangement of the atoms in crystalline bodies. The first article deals with the interference of rays reflected from the successive layers of atoms near the surface of a crystal, the forms of X-ray spectrometers, the characteristic X-ray spectra of the elements and the relations which have been found to exist between the wave-lengths of the principal lines of each element and the atomic numbers. According to Rutherford's theory of the atom, these represent the number of electrons in the nuclear charge of each atom. The second part deals more in detail with the passage of the X-rays through and their reflection from the surfaces of crystals. The principles of the method of analysis of the structure of a crystal as described by Bragg are given, and the application of them illustrated by zinc blend, diamond, calcite, certain nitrates and carbonates, and iron pyrites.

THE Comptroller-General of Patents informs us that the following notice as to renumbering specifications on publication will appear in the *Illustrated Official Journal* (*Patents*) of January 12:—In order to give the public the advantage of having abridgments of specifications up to date while retaining their numerical sequence, applications for patents made subsequent to 1915 will be given new numbers when their complete specifications are accepted or become open to public inspection before acceptance. The new numbers will start with No. 100,001 (without any indication of date), and will supersede the original application numbers in all proceedings after acceptance of the complete specifications. It is intended in future to issue abridgments of specifications in the journal a few weeks later than that in which their acceptance or publication is advertised, so that they will be available for search purposes soon after the printed copies of the specifications are on sale; but, until the system is fully in force, they will only be issued when there are sufficient to make up a full sheet of sixteen pages.

THE list of members just issued by the Liverpool Section of the Society of Chemical Industry calls for comment as a most praiseworthy beginning for the preparation of what amounts to a local "Who's Who" of chemists. Such a list will form a most useful asset in any attempt to organise the chemical profession to play a greater part in the affairs of the State. The Liverpool Section includes all members of the society residing or working in Lancashire, Cheshire, and North Wales, who are nearer of access to Liverpool than to Manchester—in all 283, a number which suggests that many chemists in the district have failed to become members of the society. The list is printed in four columns, and indicates for each individual the address, occupation, and name of the firm. A pleasing feature is the evidence afforded of the number of chemists employed by some of the leading manufacturers in the district.

STEADY progress has been made with the building of the new Southwark Bridge, although the war has hindered the delivery of materials. The work of constructing one of the river piers is described in *Engineering* for December 31. There are four of these piers, the new bridge being of five spans, instead of three, in order to coincide with the bridges to the east and west. The piers are all to be carried upon caissons founded in the London clay at a depth of 50 ft. below the Trinity high-water level. Two of the four caissons required for the river piers are 120 ft. long by 30 ft. wide, and the other two are 100 ft. 3 in. by 29 ft., the weight of each of the larger caissons being 200 tons; these are the longest caissons constructed in this country. At the present time two of the caissons have been lowered to the bed of the river,

and a third is erected and riveted complete upon its staging. In lowering the caisson, excavation within the working-chamber proceeded until a point was approached about 5 ft. from foundation level; at this point the clay at each end of the chamber was not removed, but allowed to come in contact with the descending roof of the chamber for a length of about 12 ft. from each end. The weight of the caisson, together with the concrete and masonry, approximated to 5000 tons, but there was full control of the movements, and the downward travel was stopped easily at the given level.

THE *Athenaeum* will in future continue its issue only as a monthly, and not weekly as heretofore. The new number will be published on January 15, at the price of a shilling.

THE Cambridge University Press announces the forthcoming publication of vol. ii. of Dr. W. Ridgeway's "The Early Age of Greece," and a new edition of vol. i. of the work. The following "Cambridge Tracts in Mathematics and Mathematical Physics" are in preparation:—"The Definite Integral, its Meaning and Fundamental Properties," by Dr. E. W. Hobson; "An Introduction to the Theory of Attractions," by Dr. T. J. I'A. Bromwich; "Pascal's Hexagon," by H. W. Richmond; "Lemniscate Functions," by Dr. G. B. Mathews; "Chapters on Algebraical Geometry," by Prof. H. F. Baker; and "The Integrals of Algebraic Functions," by Prof. H. F. Baker.

OUR ASTRONOMICAL COLUMN.

COMET 1915*e* (TAYLOR).—Several communications to the Paris Academy of Sciences (*Comptes rendus*, December 20) concern Taylor's comet. At the Lyons Observatory M. J. Guillaume obtained a brief observation of the comet on December 6. A feeble nucleus was seen surrounded by a nebulosity about 1′ in diameter. Its magnitude was 9·5 and the colour was bluish. Positions were measured on December 11 and 13, the comet fading to 10·5 mag. M. Paul Brück has calculated the following orbit from observations made at Algiers (December 6), Lyons (December 11), and by himself at Besançon on December 14:—

Perihelion passage, 1916, February 26·986.

$$\left.\begin{aligned} \omega &= 14^\circ\ 13'\ 46'' \\ \Omega &= 107^\circ\ 16'\ 10'' \\ i &= 22^\circ\ 44'\ 23'' \end{aligned}\right\} 1915{\cdot}0$$

$\log q = 0{\cdot}22625$

This parabolic orbit represents the middle place with an error of $-9''$ in longitude and $-32''$ in latitude, and a second calculation is to be made. With the first ephemeris sent out from Copenhagen Prof. E. Strömgren stated that the orbit was apparently periodic in short period. In Circular No. 497 (*Astronomische Nachrichten*) Prof. H. Kobold directs attention to the similarity between Messrs. Braae and Fischer-Petersen's second orbit (NATURE, December 23, 1915) and Lamp's elements for Brorsen's comet $\omega = 14^\circ\ 55{\cdot}6'$, $\Omega = 101^\circ\ 27{\cdot}6'$, $i = 29^\circ\ 23{\cdot}8'$ (1890).

An observation made at the Hill Observatory on January 1 indicates an increasing lag between the comet's actual position and that calculated from the above orbit, then amounting to about 30′ of arc in both R.A. and declination. The comet, easily seen in a three-inch finder, had evidently increased in brightness by about $2\frac{1}{2}$ magnitudes since December 16.

THE SPECTRA OF WOLF-RAYET STARS.—A most significant clue to the relationships of these extremely interesting stellar bodies was afforded by an extraordinary piece of spectroscopic research carried out at Mount Wilson upon the faint vestiges of several novæ. It was then practically established that in their latest phases these bodies assume the well-known Wolf-Rayet features. Hartmann's observations of Nova Persei were confirmed and generalised. The suggestion was made that the Wolf-Rayet stars were possibly remnants of novæ. Extremely important evidence bearing on this point has now been brought forward by Dr. Max Wolf (*Astronomische Nachrichten*, 4824). He finds that in the case of several of these stars the spectra are variable in the oscillatory mode hitherto regarded as peculiar to the later stages of novæ. The variations are described as alterations in the hydrogen bands, especially Hδ, whilst the absorption lines are said to appear at times sharp, at others masked and weakened. As Dr. Max Wolf refers to the limitations of his instrumental equipment, developments must be looked for elsewhere. A photometric study of the same stars would most obviously be of great value.

PHOTO-ELECTRIC PHOTOMETRY.—Messrs. P. Guthnick and R. Prager announce (*Astronomische Nachrichten*, 4823) that the conjectured variability of α Cygni has been confirmed by numerous photo-electric measures. Minima were found, 1914, September 28 ±10*d*, and 1915, July 5, ±10*d*, the interval being a multiple of the period. Amplitude 0·07 mag., probably in the mode of δ Cephei. Short period oscillations are indicated. The variability of α Lyræ and γ Lyræ has also been evidenced. The light changes in both cases are described as very rapid and strictly periodic for the latter. α Lyræ, however, would seem to vary in a novel manner, with an average amplitude of 0·04 mag., γ Lyræ 0·03 mag.

SOME POSSIBLY CONNECTED SOLAR AND PLANETARY PHENOMENA.—An attempt has lately been made by Herr T. Köhl to trace a connection between some planetary phenomena and solar activity (*Astronomische Nachrichten*, 4821). Thus he finds that Jupiter's northern cloud belts appear to be especially weak at times of spot maxima, and become broader and more conspicuous during minima. The recorded appearances of the secondary light on the dark side of Venus are too scanty for comparison, but the later observations suggest coincidence in time with auroral displays on earth.

DETERMINATION OF RADIAL VELOCITIES BY OBJECTIVE PRISMS.—Nearly two years ago M. Hamy suggested an ingenious method of adapting the prismatic camera to line of sight work (NATURE, vol. xcii., p. 616, January 29, 1914). Whilst the determination of radial velocities of the fainter stars is actually largely in way of being realised by increased telescopic power and suitable spectrograph design rather than by the employment of novel methods of attack, M. Hamy has not been deterred from investigating further the theory of his method. He now states (*Comptes rendus*, No. 22, 1915) that the use of a train of prisms would only necessitate a modification of the reduction formulæ, and then develops the requisite changes for the case of an instrument mounting two prisms.

RADIAL VELOCITY OF R CORONÆ BOREALIS.—Dr. H. Ludendorff, in a note in the *Astronomische Nachrichten* (No. 4823), publishes the results of some spectroscopic observations of R Coronæ. Six spectrograms were secured during June, 1913, and June, 1915, whilst the variable was at normal brightness, as was the case during earlier observations in 1902–1906. The spectrum resembles that of α Persei, and no signs of alteration could be detected. The mean radial velocity for the six plates is +24·8 km. (range=5 km.). The earlier measures gave +24·7 (range=6·4). The small range, under the conditions, leaves undecided the question of variability.

MODERN SYSTEMS OF INDEPENDENT LIGHTING AND HEATING.

(1) *Oil, Oil Gas, and Petrol-air Gas Systems.*

UNTIL quite a late period in the nineteenth century country houses were invariably lighted either by candles or oil lamps. To-day there are at our disposal many different systems of lighting, suited respectively to the cottage and the mansion.

For small houses in remote districts there is still a good deal to be said for the paraffin or petroleum lamp, provided a well-constructed and trustworthy type is employed, and the oil used is of a good standard quality. At the present time lamps giving as much as 100 candle-power can be obtained, and in favourable circumstances 300–500 candle-power hours, or even more, can be obtained per gallon of oil. The fact that the oil lamp is entirely self-contained and can readily be moved from place to place is naturally an advantage, and the low intrinsic brilliancy of the flame and the mellow colour of the light are considered pleasing by many people.

FIG. 1.—"Petrolite" lamp using upright incandescent mantle fed by air which has passed through porous material impregnated with volatile hydrocarbons.

The type of shade used with the oil lamp is of some importance. The vertical shallow tin reflectors attached to cheap forms of paraffin lamps are not very satisfactory. Such lamps are sometimes hung on the walls, throwing out the light into the room indiscriminately and giving a somewhat glaring effect. It is preferable to use some form of diffusing glass shade completely screening the light from the eyes and directing the rays downward to the table. The oil lamp is probably at its best when equipped with such a shade, and used in a central position in the room, or immediately above the surface it is intended to illuminate.

The introduction of incandescent oil lamps (*i.e.* lamps using oil or paraffin vapour with an incandescent mantle) led to a great increase in efficiency. There are now many such lamps on the market. For example, the Petrolite lamp, in which air is sucked through a porous material impregnated with suitable hydrocarbons, a draught being secured by using an exceptionally long chimney. The lamp is claimed to be exceptionally safe, as it goes out at once if accidentally upset. According to some recent tests a light of 40 candles can be obtained by burning 1½ oz. of hydrocarbon per hour.

The incandescent oil system, however, gives the most efficient results when used for relatively powerful lighting units. A well-known type is the Blanchard lamp, using paraffin vapour, with an inverted mantle. These lamps range in illuminating power from 100 to 1500 candles, and are claimed to give more than 10,000 candle-hours per gallon of oil. Their use is very simple, and the evolution of vapour can be easily started with a little spirit. Amongst other lamps of this type we may mention the Kitson, Still, and Petromax lamps, all of which are capable of giving a high candle-power, and are particularly useful for lighting large rooms, country halls, yards, etc., or for fêtes and garden parties.

The illuminants mentioned above are all self-contained and portable, and are cheap and simple in operation. On the other hand, they naturally require a little attention, so that in larger residences the trouble involved in looking after a large number of lamps in different rooms is worth consideration. Hence there has sprung up a demand for a distributing system, similar to gas and electricity, and available in localities where these methods of lighting are not available. The "petrol-air gas plants," of which there are now a number of types on the market, were designed to satisfy this need.

Petrol-air gas consists simply of air to which has been added a small percentage of petrol vapour. Such a mixture is very easily produced owing to the volatile nature of petrol, and can be generated by a small automatic plant, conveniently kept in a small outhouse. The mixture generated is then led into the house through pipes and distributed to incandescent

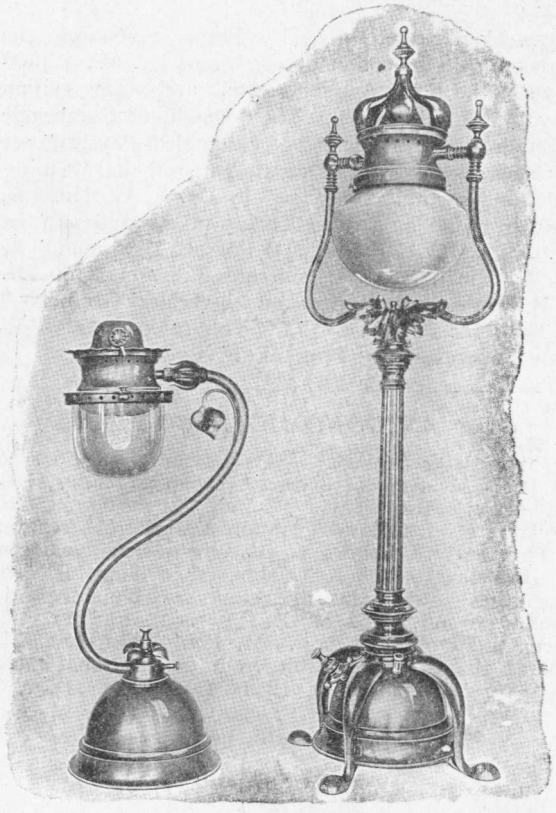

FIG. 2.—Types of small candle-power portable Blanchard incandescent oil lamps. With this system units from 100 to 1500 c.p. can be obtained.

burners in the same way as coal-gas. (This gas can only be used with mantles, and is not suitable for burning in flat flame burners.) The percentage of petrol employed is invariably small (2–6 per cent., according to the system). The gas has only a slight and not unpleasant smell. Owing to the large amount of air carried into the burner through the pipes the vitiation of the air is small, and, as there should be no objectionable impurities, the system is also clean and hygienic. In view of the small amount of petrol vapour used, the system is also claimed to be safe, and it is said that even a leak would not, in ordinary circumstances, give rise to any danger of fire or explosion. It is, however, essential that the consumer should purchase a trustworthy type of machine. In some of the earlier plants the composition of the mixture was apt to vary according to the load and

the temperature of the air, and there was even a tendency for petrol to condense in the pipes during cold weather. These defects should not exist in any trustworthy type of modern machine.

The chief elements in a petrol-air gas plant are the carburetter, in which the desired mixture of petrol and air is produced; the holder in which the gas is stored; and the compressor for the purpose of driving the gas through the pipes. The motive power may be supplied by a falling weight, hot-air engine, or water power. For country-house lighting, the falling weight is usually preferred on account of its simplicity. A trustworthy plant should operate quite automatically, yielding the same quality of gas, however many lights are turned on (within the limits of the plant), and should require little or no attention beyond filling up with petrol when necessary and occasionally winding up the weight.

A technical point of some interest is the percentage of petrol which it is desirable to include in the gas. In some cases, for example in the "County" petrol-air gas system, the comparatively rich mixture of 6 per cent. is preferred, and it is considered that this enables the plant to be designed and operated on highly scientific lines, and that it is of value in enabling a mixture of constant composition to be obtained, as well as desirable in the interests of safety.

In other well-known makes, for example, the Willett system, the percentage of petrol is 2 per cent. only. This is stated to operate quite satisfactorily, and it is also claimed that ordinary motor-car petrol can be used, and that no special variety of lighting spirit is required.

A petrol-air gas system enables lights to be installed permanently in position and used either as central or units or wall brackets. The ordinary type of inverted burner used is of the Bijou type, from which as much as 70–80 candle-power may be obtained with new mantles. In favourable circumstances 100–120 of these lights can be run for a consumption of one gallon of petrol per hour. A small plant, feeding

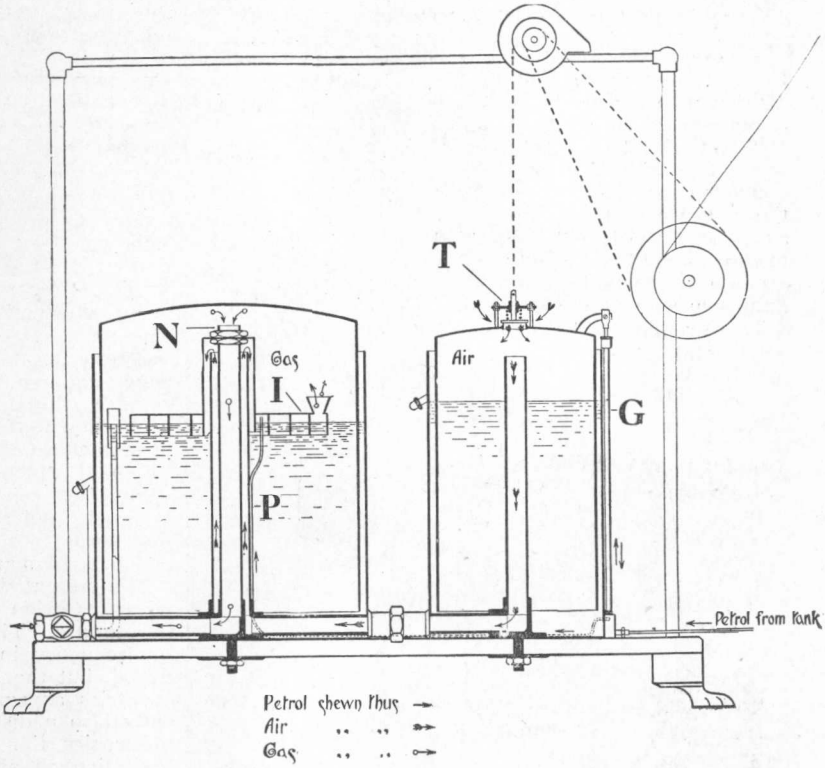

FIG. 3a.—Sectional view of "County" petrol-air gas plant. In this diagram three types of arrows are used to denote the respective paths taken by the air, petrol, and the resulting gas. The plant consists in the main of two copper bells working in water seals, the smaller of which acts as an air pump whilst the larger constitutes the holder for the gas as it is made. The air-pumping bell is made to rise and fall by means of the weights and on its upstroke takes in air through the valve T. On reaching the top of its stroke it is disengaged from the action of the weights (which are then held stationary), and the valve T closing, the air-bell falls by its own weight and drives air down the central pipe K into the larger bell *via* the pipe L and the annulus F. Before reaching the larger bell, however, it is caused to pass close along the surface of the carburetter by the baffle plate I. The petrol is delivered on to the surface of the carburetter by the petrol pump G in small amounts (a teaspoonful or so at a time) along the small pipe P. The petrol pump G, being attached directly to the air-bell, makes stroke for stroke with it, thus ensuring that air is never delivered without its complement of petrol under any conditions of running. The gas is delivered to the service down the central pipe at N.

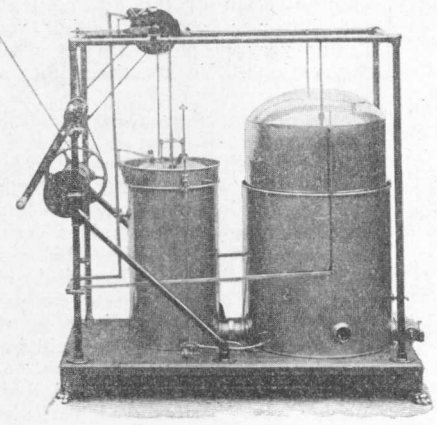

FIG. 3.—General view of "County" petrol-air gas plant.

10–20 lights, would probably cost about 25*l*.–35*l*. A larger size, capable of supplying 100 lights, about 100*l*.–120*l*. The complete cost of lighting installation, including plant, piping, and simple fixtures, would probably work out to between two and three times the above figures. Much, however, depends on the expenditure on fittings and the shed for housing the plant, and the distance from which materials have to be supplied. Prices have naturally been affected somewhat by the war. A consumer should remember that in remote places it is not always easy to get prompt technical assistance, and should therefore be careful to select a thoroughly up-to-date and trustworthy make of machine, even if somewhat more expensive than others on the market.

The above remarks have referred mainly to the use of petrol-air gas plants for country houses, but there are also opportunities for its use in small workshops, laboratories, etc. It has also been used occasionally for military camps and even for village lighting, but in such cases the nature of the area to be covered has an important bearing on the method of illumination supplied. In a large and scattered area the

question will arise whether it is worth while to run mains from the nearest gas or electrical supply; or whether it is not more economical, for a temporary installation, to rely exclusively on portable illuminants such as those described in the earlier portion of the article, and to avoid the use of piping altogether.

The fact that petrol-air gas can be readily applied for heating is also an advantage, especially in laboratories where bunsen burners and small heating appliances are much used. In country houses petrol-air gas may also be used for small cooking ranges, the usual size of which consumes an amount of petrol equivalent to about twenty lights. Stoves for use in the fireplace to heat rooms can also be supplied, but as a rule the small householder finds it preferable to use a coal or wood fire rather than incur the expense of installing the exceptionally large plant necessary to heat a number of rooms.

There remain to be mentioned the systems of light-

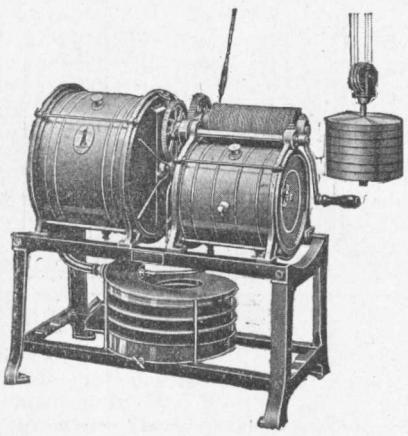

FIG. 4.—General view of Willett petrol-air gas plant. The plant consists of three chief parts—air compressor, petrol container, and spiral carburetter. The air compressor contains a cylindrical drum having in it a number of "scoops" so shaped as to produce a series of helical channels; the lower portion of the drum is filled with water. The petrol drum contains a number of small cups attached to the ends of rods which are fixed to a revolving spindle. These cups discharge their contents into a funnel-shaped receptacle, which in turn is controlled by the petrol regulator. Both the scoops in the air compressor and the spindle carrying the cups in the petrol drum are actuated by the suspended weight and work in perfect uniformity. The helical scoops in revolving take up a measured quantity of air which is compressed and discharged into a rectangular tank at the side, from whence it passes into the carburetter. Meantime the carburetter receives a regulated amount of petrol in the manner described. The inter-connection of the apparatus for supplying air and petrol maintains the correct proportions of these constituents; no holder is needed to store the gas which is generated as required, the machine automatically increasing its speed as more lights are turned on and *vice versâ*.

ing and heating which generate gas from heavy oils, fats, etc., which require heat for distillation. These systems are claimed to be highly economical on a large scale, and are usually employed for large buildings, institutions, factories, country railway stations, etc. Many railways make their own oil gas, which is compressed and used for carriage lighting.

The Mansfield oil gas producer is widely used for generating this quality of gas, and is claimed to be applicable to a wide variety of fuels, such as creosote, palm oil, kerosene, and even tallow and unrefined fat. The oil is stored in a suitable tank and guided in a fine stream into a retort heated by a wood or coal fire. In this way a permanent oil gas is produced which, after purification, is stored in a holder and supplied through pipes in the usual way. The gas produced may be used either with incandescent mantles or in a flat flame burner. It may also be used for heating, having a high calorific power. In some cases a portion of the gas is used for cooking and heating water, and the remainder is utilised to drive an engine and dynamo, furnishing electric light. A system of this kind naturally requires some attention, but is claimed to be capable of being worked by unskilled labour, and to be very simple in operation.

RESEARCHES ON SPRUE.[1]

SPRUE is a disease of chronic course, the main features of which are a frothy diarrhœa generally accompanied by a sore tongue; the disease as it progresses producing severe anæmia and exhaustion. The word sprue in English medical literature was first used by Manson in 1880, and is apparently the anglicised form of the Dutch spruw. One would like to know something of the origin of this Dutch word. The form sproo was also used in the year 1825 in Scotland for "a disease affecting the mouth of very young children." This disease is in all probability the same as thrush, and it is important to note in this connection that the condition of the tongue in thrush is similar to that in sprue. The word thrush, the origin of which is obscure, is not known before the seventeenth century, when Pepys speaks of "a fever, a thrush, and a hickup." It may also be mentioned that sprue in Scotland was the term used for "that which is thrown off in casting metals" (scoria).

The present work deals with the disease in Ceylon, where "Ceylon sore mouth" is one of the names for the disease. There are no figures available to show its frequency in Europeans or in the natives in the island, but that it does occur in the latter in various countries appears to be fairly certain. It is apparently also a disease determined by long residence in the tropics, though on all these points one speaks with hesitation as accurate data are not available. That dysentery is a common predisposing cause there appears to be no doubt, but whether there is any other closer connection between the two diseases is doubtful.

A sore tongue is one of the features of sprue, and microscopically the epithelium is found to be desquamating. This dead epithelium is infiltrated with yeasts, and in some cases the yeast threads appear to be actually invading the living cells. This is not, however, found to be the case in the stomach or gut, which are also inflamed, though the gut contents contain masses of yeast, and yeasts are the commonest organisms in motions passed shortly before death. This infection of the gut contents with yeasts does not, however, occur in other wasting diseases, the author very properly having made adequate control observations. Yeasts, then, not only can be cultivated from the majority of sprue stools and salivas, but in the acute stage they are the most prevalent organisms in the tongue lesions, saliva, and motions.

Now thrush, a common disease of infants in temperate climates, is generally believed to be due to yeasts, and in some respects—*e.g.* atrophy of the tongue epithelium—resembles sprue. The author, indeed, inclines to the view that yeasts are in fact the cause of the disease. One might object, however, that if this were so one would expect sprue to be a far commoner disease than it is, as yeasts in the tropics are ubiquitous. The view held by some authors that it has affinities to scurvy is an "attractive" one, and is supported by the beneficial effect of a fruit diet such as strawberries or bael fruit. This work is an interesting record of a careful research, valuable although inconclusive in its results. The plate of

[1] "A Report on Researches on Sprue in Ceylon, 1912–14." By Dr. P. H. Bahr. Pp. ix + 155. (Cambridge: At the University Press, 1915.) Price 7s. 6d. net.

sprue tongues has the merit of clearness, although the colours are not those of nature. We feel sure it would "pay" the Planters' Association in Ceylon to employ permanently one or more medical men to investigate the subject further. J. W. W. S.

SCIENTIFIC COMMITTEES ON NATIONAL PROBLEMS.

WE have referred from time to time to the various scientific committees appointed by the Government and scientific societies to deal with problems arising out of the war. It seems worth while to bring together now a list of such committees and a short statement of their work so far as that can be made known. It will be noticed that, with the exception of the Advisory Council of the Privy Council Committee and the Council and Committee of British Dyes (Ltd.), no provision is made for the payment of the experts in science and technology who are serving on other committees appointed by the Government and by scientific societies.

GOVERNMENT SCIENTIFIC COMMITTEES.

The Board of Invention and Research appointed last July to assist the Admiralty in co-ordinating and encouraging scientific effort in relation to the requirements of the Naval Service consists of the following Central Committee and Panel of Consultants, who advise the main committee on questions referred to them :—

Central Committee: Admiral of the Fleet Lord Fisher of Kilverstone (president), Sir J. J. Thomson, Sir Charles A. Parsons, and Dr. G. T. Beilby. *Panel*: Prof H. B. Baker, Prof. W. H. Bragg, Prof. H. C. H. Carpenter, Sir William Crookes, Mr. W. Duddell, Prof. P. F. Frankland, Prof. B. Hopkinson, Sir Oliver Lodge, Prof. W. J. Pope, Sir Ernest Rutherford, Mr. G. Gerald Stoney, and the Hon. R. J. Strutt. *Secretary and Naval Assistant*: Captain Thomas E. Crease, R.N.

We are informed by the Secretary of the Lords Commissioners of the Admiralty that the services of the members and the scientific experts on the Central Committee and the Panel of Consultants of the Board of Invention and Research are given gratuitously.

A Munitions Inventions Department of the Ministry of Munitions of War, with Mr. E. W. Moir as Comptroller, was appointed in August last to consider projects for inventions relating to munitions for warfare on land or matters pertaining thereto. The Advisory Panel of scientific and other experts is as follows :— Prof. A. W. Crossley, Mr. Horace Darwin, Dr. S. Z. de Ferranti, Mr. A. MacDougall Duckham, Mr. W. Duddell, Dr. R. T. Glazebrook, Col. H. E. F. Goold-Adams, Sir Robert A. Hadfield, Prof. J. S. Haldane, Col. N. B. Heffernan, Sir Alexander B. W. Kennedy, Mr. F. W. Lanchester, Prof. A. P. Laurie, Mr. Michael Longridge, Dr. W. H. Maw, Sir Hiram S. Maxim, Capt. A. U. Moore, Sir Henry Norman, Bart., Dr. F. G. Ogilvie, Maj.-Gen. Sir George K. Scott-Moncrieff, Mr. F. Wilfrid S. Stokes, Mr. J. Swinburne, Sir J. J. Thomson, Mr. A. J. Walter, Mr. C. J. Wilson, and Lieut.-Col. J. C. Matheson. The secretary to the Advisory Panel is Mr. H. W. Dickinson, Munitions Inventions Department, Princes Street, Westminster, S.W.

The Comptroller of the Munitions Inventions Department assures us that these gentlemen are not paid and that their services in all cases are voluntary. He informs us further that the work of the Department is co-ordinated with that of the Board of Invention and Research, and that a constant interchange of information and ideas takes place.

In July last, Mr. Arthur Henderson, President of the Board of Education, issued a White Paper describing the Government scheme designed to establish a permanent organisation for the promotion of industrial and scientific research. A sum of 30,000*l.* has been provided for the purposes of the scheme during the first year. The circular points out that the scheme is in no way intended to replace or interfere with the arrangements which have been or may be made by the War Office or Admiralty or Ministry of Munitions to obtain scientific advice and investigation in connection with the provision of munitions of war. The scheme provides for the establishment of :— (*a*) A Committee of the Privy Council responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research; (*b*) a small Advisory Council responsible to the Committee of Council and composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research. The Committee of Council consists of the Lord President, the Chancellor of the Exchequer, the Secretary for Scotland, the President of the Board of Trade, the President of the Board of Education (who is to be vice-president of the Committee), the Chief Secretary for Ireland, together with such other Ministers and individual members of the Council as it may be thought desirable to add. The first non-official members of the Committee are :— Lord Haldane, Mr. A. H. D. Acland, and Mr. J. A. Pease. The first members of the Advisory Council are :—Lord Rayleigh, Dr. G. T. Beilby, Mr. W. Duddell, Prof. B. Hopkinson, Prof. J. A. M'Celland, and Mr. R. Threlfall, with Sir William S. M'Cormick as administrative chairman. The primary functions of the Advisory Council will be to advise the Committee of Council on (i) proposals for instituting specific researches; (ii) proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; (iii) the establishment and award of research studentships and fellowships. The Advisory Council will also be available, if requested, to advise the several Education Departments as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research. It is contemplated that the Advisory Council will work largely through sub-committees reinforced by suitable experts in the particular branch of science or industry concerned. In pursuance of the Order in Council, *the Treasury has authorised the payment of remuneration to the members of the Advisory Council.*

The Minister of Munitions of War, with the concurrence of the Home Secretary, has appointed a committee to consider and advise on questions of industrial fatigue, hours of labour, and other matters affecting the personal health and physical efficiency of workers in munition factories and workshops. The committee is constituted as follows :—Sir George Newman (chairman); Sir Thomas Barlow, Bart., Mr. G. Bellhouse, Prof. A. E. Boycott, Mr. J. R. Clynes, Mr. E. L. Collis, Dr. W. M. Fletcher, Prof. Leonard E. Hill, Mr. Samuel Osborn, Miss R. E. Squire, and Mrs. H. J. Tennant.

The president of the Board of Agriculture and Fisheries has appointed a committee (consisting of Lord Middleton (chairman), Mr. Henry Chaplin, Sir Ailwyn Fellowes, the Hon. Alexander Parker, Major Sir M. Burrell, Bart., Sir G. Greenall, Bart., and Capt. M. S. Adye) to consider and advise the Board as to the steps which should be taken to secure the production and maintenance in England and Wales of a supply of horses suitable and sufficient for military purposes, especially on mobilisation.

The President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to make arrangements with a view to the maintenance, so far as possible, of adequate supplies of fertilisers for the use of farmers in the United Kingdom. The Committee is constituted as follows:—Mr. F. D. Acland, Parliamentary Secretary to the Board of Agriculture and Fisheries (chairman); Mr. R. H. Rew, Board of Agriculture and Fisheries; Mr. T. H. Middleton, Board of Agriculture and Fisheries; Mr. G. J. Stanley, Board of Trade; Mr. J. Dundas White, Scottish office; Mr. H. Ross Skinner, Ministry of Munitions; Mr. E. J. Foley, Admiralty; and Mr. R. J. Thompson, Board of Agriculture and Fisheries.

The Secretary of State for the Colonies has appointed a committee to consider and report upon the present condition and the prospects of the West African trade in palm kernels and other edible and oil-producing nuts and seeds and to make recommendations for the promotion, in the United Kingdom, of the industries dependent thereon. The committee as at present constituted is composed of Mr. Steel Maitland (chairman), Sir G. Fiddes, Sir F. Lugard, Sir Hugh Clifford, Sir Owen Philipps, Mr. G. A. Moore, Mr. T. Walkden, Sir W. G. Watson, Bart., Mr. L. Couper, Prof. W. R. Dunstan, Mr. T. Middleton, Mr. T. Worthington, and Mr. T. Wiles.

British Dyes (Ltd.).

In February last the committee of users of dyes appointed to confer with the Board of Trade as to a national dye scheme adopted a scheme to form a company with an initial share capital of 2,000,000*l.*, of which 1,000,000*l.* was issued in the first instance. The Government agreed to make to the company a loan for twenty-five years corresponding to the amount of share capital subscribed up to a total of 1,000,000*l.*, and a smaller proportion beyond that total. The Government advance is to bear interest at 4 per cent. per annum, payable only out of net profits, the interest to be cumulative only after the first five years. In addition, and with the desire of promoting research, the Government undertook for a period of ten years to make a grant to the company for the purposes of experimental and laboratory work up to an amount not exceeding in the aggregate 100,000*l.* Chemical research was thus officially recognised and endowed as an essential factor in solving a national industrial problem.

Announcement was made in July that the board of directors of British Dyes (Limited) had established a Research Department, and had appointed Dr. G. T. Morgan, Royal College of Science for Ireland, Dublin, to become the head of the department. The board, which also appointed a Technical Committee, consists of Dr. M. O. Forster (chairman), Dr. J. C. Cain, Dr. G. T. Morgan, and Mr. J. Turner. An Advisory Council, which was appointed under the chairmanship of the late Prof. Raphael Meldola, is constituted as follows:—Prof. J. N. Collie, University College, London; Prof. A. W. Crossley, King's College, London; Prof. Percy F. Frankland, the University, Birmingham; Prof. G. G. Henderson, Royal Technical College, Glasgow; Prof. J. T. Hewitt, East London College, London; Prof. F. S. Kipping, University College, Nottingham; Prof. A. Lapworth, the University, Manchester; Prof. A. G. Perkin, the University, Leeds; Prof. W. H. Perkin, the University, Oxford; Prof. W. J. Pope, the University, Cambridge; Prof. J. F. Thorpe, Royal College of Science, South Kensington; and Prof. W. P. Wynne, the University, Sheffield. The members of the Technical Committee are *ex officio* members of the Advisory Council. *Payment is to be made to these chemists,* but the secretary of the company informs us that he is not at liberty to disclose the scale.

Royal Society.

On November 5, 1914, the council resolved "That the following be appointed a committee to organise assistance to the Government in conducting or suggesting scientific investigations in relation to the war, the committee to have power to add to their number, and to appoint sub-committees not necessarily restricted to fellows of the society:—Sir William Crookes, Prof. Schuster, Mr. W. Duddell, Sir Alfred Ewing, Dr. R. T. Glazebrook, Admiral Sir Henry Jackson, Sir Oliver Lodge, Sir William Ramsay, Lord Rayleigh, Sir Edward Thorpe." On January 21, 1915, an additional committee (the War Industries Committee) was appointed by the council to take over questions arising out of the war and affecting the industries of the country referred to the society by Government departments.

After a short experience the council came to the conclusion that it should be directly responsible itself for the co-ordination and control of the war work, and, accordingly, in June last the original committee was discharged, and council was constituted a General War Committee, the original sub-committees being re-nominated as four sectional committees. The functions of the War Industries Committee were transferred to the sectional Committee for Chemistry. These sectional committees have met regularly throughout the year, and have discussed and investigated many important questions, either submitted by Government departments or initiated by themselves. They have been placed in direct communication with the departments of Government concerned, and in each case representatives of the principal war departments have been appointed to serve on the committee.

In June last the council decided to form a register of those who are willing and able to aid in meeting the demands of the Government for scientific help. A circular letter inviting particulars of service proffered was sent to all the fellows, and met with a large response from them and from others to whom the project was made known. The register thus formed has been placed at the disposition of Government departments for reference.

A committee has been appointed to consider the advisability of entering into communication with technical and other scientific societies, with the view of establishing a permanent board for the discussion of questions in which joint action seems desirable. This committee will submit the draft of a scheme to the council, so as to put the council in a better position to arrive at a definite conclusion on the subject.

Those men of science who are working under the Royal Society's committees are not receiving any payment from the society for doing so.

Chemical Society.

With the object of assisting the Government to employ the chemical talent in the nation, the council of the Chemical Society in June last constituted itself a consultative body which should meet at frequent intervals to consider, organise, and utilise for the benefit of the country all suggestions, inventions, and offers of assistance it might receive.

On July 1 the president addressed a letter to every fellow of the society, inviting him to forward to the council any such suggestions and inventions, and asking him also to indicate on the form provided what services he could best render to the nation. A very gratifying response has been received to this appeal; many suggestions and inventions have been submitted to the council by fellows and by others, and numerous offers of voluntary assistance of whole or partial time, and even of relinquishing present positions altogether in order to devote their energy to the nation's service,

have been received from fellows in every part of the Empire. All these offers of assistance have been tabulated and a careful record has been kept.

In order to carry out effectively the consideration and reporting on the suggestions received, the council invited the co-operation of the following societies:—Royal Agricultural Society, Biochemical Society, Society of Chemical Industry, Society of Dyers and Colorists, Faraday Society, Institute of Chemistry, Institute of Metals, Institution of Mining and Metallurgy, Pharmaceutical Society, Physical Society, Society of Public Analysts. This was loyally and readily given by all; each society undertook to report on such inventions as came within its own special province by means of a special committee, of which it nominated six members in addition to two members of the council of the Chemical Society. In this way ten committees, each consisting of eight members, were formed, and cover the whole field of chemical activity. Each committee reports to the council the results of its deliberations, and those suggestions which are considered suitable are then sent on to the proper Government authorities, who have expressed their high appreciation of the valuable assistance thus afforded them. The society has also been instrumental in aiding the Ministry of Munitions with regard to the supply of chemists for the manufacture of munitions of war.

In addition to these special committees, which deal chiefly with matters of practical detail and utility, a general committee has been formed consisting of two members elected by the Chemical Society and by each of the above-mentioned societies. The object of this general committee is to consider and discuss all questions of general policy, not only those arising from the war, but also those matters on which it is desirable to have the opinion of a body thoroughly representative of every department of chemical science.

Further, the Chemical Society has been active in connection with the Government scheme for the organisation and development of scientific and industrial research under the auspices of the Board of Education. The president has addressed an urgent appeal to the fellows to exert their energy so as to make the scheme a success, and has invited them to forward to the society suggestions for suitable researches, especially those having a direct bearing on chemical industry and its promotion. Many valuable suggestions have already been received and are under consideration by the council. *No payment of any kind is being made to any member of these councils or committees for services rendered in connection with this work.*

Physical Society.

The council of the Physical Society decided in June last to make a register of the fellows, showing the special knowledge of each and the services each would be willing to perform voluntarily in connection with the war. In addition to this register, and quite distinct from it, arrangements were made for receiving from fellows any kind of scientific suggestion likely to be of use in the prosecution of the war. A number of suggestions have been received and have been passed to the proper Government departments.

As regards the register, a form was issued in July, and about half the fellows of the society returned it duly filled. Each recipient was asked details of:—(1) The branches of science, or appliances, of which he has special knowledge; (2) his laboratory or workshop facilities; (3) his willingness (*a*) to supply specialist information to the council, (*b*) to carry out experimental work, (*c*) to make models or drawings, (*d*) to give facilities to other workers, (*e*) to make calculations or numerical tables, (*f*) to make abstracts of technical papers, (*g*) to make reports on recent developments, to do clerical work, etc.

The various Government departments were notified in August of the existence of this register, and it was made use of by the Admiralty Inventions Board and by the Metropolitan Munitions Committee. Since then the society has supplied complete copies of the register, classified in subjects, to all the Government departments concerned and to certain other public bodies. *Any services rendered to the State under these schemes are given without remuneration by the fellows offering them.*

British Association.

As an outcome of the Manchester meeting, the British Association has invited the following gentlemen to serve on a committee to consider and report upon the question of fuel economy (utilisation of coal and smoke prevention), from a national point of view:—Prof. W. A. Bone, of the Imperial College of Science and Technology, London (chairman); Mr. E. D. Simon, chairman of the Manchester Air Pollution Committee (secretary); Profs. P. P. Bedson (Armstrong College, Newcastle-on-Tyne), J. W. Cobb and J. B. Cohen (Leeds University), H. B. Dixon (Manchester University), Thomas Gray (Royal Technical College, Glasgow), H. S. Hele-Shaw (London), L. T. O'Shea and W. P. Wynne (Sheffield University), and Richard Threlfall (Birmingham), together with Dr. G. T. Beilby (Glasgow), Mr. Ernest Bury, and Dr. J. E. Stead (Middlesbrough and the Cleveland district). The committee, which is empowered to add if necessary to its members, has been selected so as to include representative chemists, engineers, and technologists from all the principal industrial areas.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—By the will of the late Mr. Christopher Welch, of Wadham College, a well-known authority on musical subjects, a large sum has been placed at the disposal of the University for the endowment of scholarships in biology. This is the most important bequest of the kind that the University has received for many years. The conditions under which the scholarships may be gained and held, together with other matters of detail, will be announced in due course. The will contains the notable provision that under certain contingencies the money may go to the support of hospitals, but no hospital where vivisection is disallowed or discountenanced is to benefit, "anti-vivisectionists being enemies of the human race."

The following courses of free advanced lectures for students of the University of London and others are announced:—Six lectures on "Stelar Anatomy in Angiosperms" will be given at Bedford College by Miss E. N. Thomas, on Mondays, beginning on January 24; nine lectures with practical work in dynamical meteorology will be held at the Meteorological Office, South Kensington, by Sir Napier Shaw, on Fridays, beginning on January 21. A practical course of statistical meteorology will be available for those who wish to work at that section. The fortnightly meetings at the Meteorological Office for discussion of important contributions to meteorology, chiefly in Colonial or foreign journals, will be resumed on Monday, January 10, at 5 p.m., and will be continued on alternate Mondays until March 20, inclusive.

The Association of Public School Science Masters met on January 4 at the London Day Training College in Southampton Row, and a further meeting is being held as we go to press. The opening address by Sir William Osler was on "The Fateful Years: Fifteen to Seventeen." If he started from the years 1915 to

1917, what he said applied generally to the ages fifteen to seventeen. He pressed for the teaching at school of the combined course in chemistry, physics, and biology, generally known as the preliminary scientific for medical students. Discussion showed that this was already done in many of the schools represented, and that such work was recognised by almost every university except Oxford. In the afternoon Mr. Christopher Turnor was equally convincing in showing the school science course should afford a sound foundation for the duties of a rural landlord. Later Mr. M. D. Hill, of Eton, invited discussion on the management of school museums. A very useful adjunct to this conference is the exhibition of standard scientific text-books by publishing firms, and of scientific apparatus by several of the best-known dealers. Conspicuous among these were glassware and laboratory balances of British make.

THE fourth annual conference of educational associations is being held this week at the University of London. The arrangements have been made by a committee, on which nearly thirty associations are represented, and more than twenty of these hold their meetings under the same roof. Some meetings are sitting simultaneously, others follow in quick succession. The Educational Exhibition, representing sixteen different publishing firms, stands conveniently open for those who wish to see the newest school books. The inaugural meeting was held on Monday afternoon, January 3, when the Vice-Chancellor of London University, Sir Alfred Pearce Gould, took the chair, and Sir Oliver Lodge gave his address on "Education after the War." This proved to be a strong plea for science and natural history in the education of ordinary boys of thirteen and fourteen years of age. It is proposed to publish this and other papers in one volume after the conference. The conference is being extremely well attended; the audience at Sir Oliver Lodge's address filled the Great Hall of the University. After the address the Society of Education held an open meeting to hear Dr. A. R. Abelson on "The Comparative Study of Normal and Subnormal Children," and Mr. C. Burt on "Some Results of Mental and Scholastic Tests."

THE issue for December last of the Bulletin of the Massachusetts Institute of Technology is devoted to a catalogue of the officers and students of the institute, together with a statement of the requirements for admission and a description of the courses of instruction. So extensive are the activities described that the volume runs to nearly six hundred pages. Special interest attaches to the opportunities for research offered by the institute. Facilities for original investigation are afforded in all the departmental laboratories devoted to advanced work, as well as in separately organised research laboratories. Such laboratories have been provided for physical chemistry, applied chemistry, electrical engineering, and sanitary science, among other subjects. In addition, the institute maintains the Hawaiian Volcano Observatory, on the edge of the cliff that bounds the greater crater of Kilauea in Hawaii, where continuous registration and record of lava movements and effects peculiar to the district are carried out, and experiments on the kindred physical and chemical phenomena are undertaken. In accordance with an agreement between Harvard University and the institute, male students may receive certain benefits from the University. These benefits are confined to students registering in civil, mechanical, mining, electrical, or sanitary engineering. Such students will be entitled to the same rights and privileges as students in the professional schools of the University, and will be eligible for degrees from the University, in addition to those that they may receive from the institute.

THE report of the work of the Department of Technology of the City and Guilds of London Institute for the session 1914–15 has now been published by Mr. John Murray. The effect of the war on the country in general is reflected in the reduced numbers of students attending classes for technical training and presenting themselves for examination at the end of their courses of instruction. Apart from the large numbers who have enlisted in the Navy or Army, and whose technical training has been thereby suspended, both the extreme activity in certain industries and districts and the slackness and dislocation of business in other trades have been conditions unfavourable to the steady attendance and training of young men in technical classes. Although the total number of classes registered in technological subjects remained practically the same, the number of students in attendance fell from 55,996 to 47,050 this year—a reduction of nearly 16 per cent. on the previous year's figures. Correspondingly the number of candidates who presented themselves for examination in technology from centres in the United Kingdom fell from 23,119 to 15,623, a decrease of nearly 32½ per cent. Towards the close of the session several technical schools rendered valuable help to the Ministry of Munitions by using their workshops for making those articles connected with munitions of war for which their machinery was best adapted, and by training men to take their place in engineering firms executing Government contracts. Notwithstanding the war, the institute again held its examinations in India and the Overseas Dominions. New Zealand and South Africa each contributed contingents of candidates, and others were examined in Melbourne, Jamaica, Malta, and Singapore.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 21.—Dr. J. M. Purser in the chair.—Prof. W. **Brown**: The change of length in nickel wires of different rigidities, due to alternating magnetic fields of frequencies up to 150 per second. The change in the length of nickel wire, due to the application of magnetic fields, depends on the rigidity of the wire, and on the frequency of the applied alternating magnetic field. For a magnetic field of 200 c.g.s. units with a decrease in the rigidity of about 12½ per cent., the contraction of the wire is increased about 60 per cent. for a direct magnetic field, and about 80 per cent. for an alternating magnetic field of frequency 150 per second; and when the frequency of the alternating magnetic field is increased six times the contraction is increased 24 per cent. for a light longitudinal load on the wire, and 9 per cent. for a load sixteen times greater, that is, when the wire has a rigidity of 810×10^6 grams per sq. cm.—G. H. **Pethybridge**: The verticillium disease of the potato. The disease is a specific type of hadromycosis caused by the fungus *V. albo-atrum,* R. et B., which invades the wood vessels of all the organs of the plant and causes its premature death by desiccation. The fungus enters the wood system of the new tubers, hibernates there, and causes the infection of the plants produced when such tubers are used as "seed." The fungus has been obtained and studied in pure culture, and infection experiments have proved its parasitic nature.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Osmotic pressures in plants. VI.—On the composition of the sap in the conducting tracts of trees at different levels and at different seasons of the year. Sap centrifuged from the wood at the top of the stem

of a deciduous tree has a greater pressure than that from the root and lower portions. The excess is greatest in early spring, when the sugar content becomes very considerable, though appreciable quantities of sugars, mainly sucrose, are always present. The electrolytes increase noticeably in late spring. In evergreens a more uniform distribution of osmotic pressures is found in the stem, and the seasonal changes are not so sharp.

EDINBURGH.

Royal Society, December 6, 1915.—Dr. John Horne, president, in the chair.—C. **Tweedie**: The *Geometria organica* of Colin MacLaurin. This was a presentation in modern form of MacLaurin's treatise on the properties of plane curves, a treatise which was much admired by Newton. With the exception of the French school of geometers, mathematicians had largely neglected this work of MacLaurin, who had enunciated theorems and established relations which are usually ascribed to later workers. In presenting the treatise in English dress Mr. Tweedie had greatly simplified the analytical methods, but had left practically untouched the geometrical reasoning, which for elegance and lucidity could not be surpassed.—Prof. R. J. **Harvey-Gibson** and Miss M. **Bradley**: The anatomy of the stem of the Papaveraceæ. This was the first of a series of careful investigations into the characters of plants belonging to the lower Dicotyledons. Throughout the Papaveraceæ the stem structure was very uniform, the chief characteristics being (*a*) a subepidermal band of chlorophyll-bearing tissue, (*b*) a sclerotic pericycle (with some exceptions), (*c*) a massive pith, often fistular.—W. E. **Collinge**: A small collection of terrestrial Isopoda from Spain, with descriptions of four new species. The collection was from the Cambridge University of Zoology, and the author was indebted to the kindness of Dr. Leonard Doncaster for the opportunity of examining it. There were seven species, of which four were certainly new, but two were too imperfect to admit of identification. The new species were *Porcellio batesoni, P. explanatus, Armadillidium nitidulus,* and *Cubaris invenustus.*

December 20, 1915.—Dr. John Horne, president, in the chair.—E. G. **Ritchie**: The torsional vibrations of beams of commercial section. In beams of circular section the torsional rigidity depends on the polar moment of inertia of the area. For non-circular sections de St. Venant had proved that important corrections must be applied. In a previous paper Mr. Ritchie showed that the effective moment of inertia to be used instead of the polar moment of inertia in beams of commercial section, such as the I-section, the Channel, the Tee, the Angle, could be expressed in the form A^n/m, where A is the area of section and n and m are constants depending upon the type of section. In the present paper, experiments on the torsional vibrations of loaded beams of commercial section were carried out and the results compared with the theoretical values indicated. The comparisons were satisfactory.—E. H. Cunningham **Craig**: The origin of oil shale. After a detailed discussion of the field evidence regarding the occurrence of oil shales and oil fields in different parts of the world, the author elaborated a new theory of the origin of oil shale, the main points of which were as follows:—Kerogen is formed by the inspissation of petroleum, during which the nitrogen and sulphur compounds become concentrated in the most inspissated or weathered products. At a certain stage of inspissation, which is reached gradually, the organic matter becomes insoluble in carbon disulphide and ceases to be bitumen. An oil shale is formed by the power of certain clays or shales of absorbing and adsorbing inspissated petroleum, particularly unsaturated hydrocarbons.—Dr. Thomas **Muir**: The theory of circulants from 1880 to 1900.

PARIS.

Academy of Sciences, December 20, 1915.—M. Ed. Perrier in the chair.—G. **Bigourdan**: Jean de Lignières, his nationality and work.—Edouard **Branly**: The conductivity of a thin layer of air between two metallic surfaces. Details of experiments on the conductivity of thin layers of air, of known thickness, for continuous currents.—G. **Gouy**: The form of the X-rays. A theoretical examination of the problem of the production of real foci of the X-rays, by the aid of crystalline reflection.—M. de **Sparre**: The trajectory of projectiles thrown with a great initial velocity with an angle of projection in the neighbourhood of 45°, and under the influence of the diminution of the density of the air.—J. **Guillaume**: Observations of the Taylor comet, made with the Brünner equatorial of the Lyons Observatory. Two positions are given for December 11, one for December 13. On December 6, the comet showed as a nebulosity of about 1′, with slight central condensation. Magnitude, 9·5; colour bluish. On December 11 it appeared brighter; magnitude not under 6.—Paul **Bruck**: Observation and first elements of the Taylor comet.—Nicolas **Kryloff**: The convergence of quadratures.—Marcel **Brillouin**: The problems of mathematical physics and their general numerical solution. A method of constructing series which lead to the numerical calculation of solutions of all problems of mathematical physics defined by one or more linear partial differential equations, whatever the form of the limiting surface.—A. **Targonski**: The value of the charge of the electron deduced from the calculation of Brownian deviations. A comparison of Millikan's method, based on the Stokes-Cunningham formula, and that based on the observation of Brownian motion. Leaving out of account experiments where the particles have been produced in the electric arc, the results obtained by the two methods agree better when the mean free path of the molecules of the gas is large relatively to the radius of the particle observed.—Gabriel **Sizes**: Complement of the law of resonance of sonorous bodies.—Jean **Danysz** and Louis **Wertenstein**: An attempt to influence the velocity of radio-active transformations by the α rays. From the results of the experiments described it is concluded that even encounters with α particles with atoms are powerless to provoke an artificial radio-activity, or a premature transformation of the atom struck.—Albert **Colson**: Contradictions between the found and calculated solubility of certain sodium salts.—B. **Bogitch**: The solidification curve of the system ammonium nitrate—lead nitrate.—L. **Tschugaeff** and J. **Tschernjaeff**: The series of triamino-aquo salts of bivalent platinum $(Pt.3NH_3,H_2O)X_2$.—M. **Deprat**: The discovery of the Middle and Upper Cambrian in Tonkin, in Kwong-Si, and in southern Yunnan.—C. **Sauvageau**: The heterogamic sexuality of *Saccorhiza bulbosa.*

NEW SOUTH WALES.

Linnean Society, October 27.—Mr. A. G. Hamilton, president, in the chair.—R. **Etheridge**, Jun., and J. **Mitchell**: The Siluran trilobites of New South Wales, with references to those of other parts of Australia. Part v., Encrinuridæ. The genera of the family are briefly referred to in a general way, and the foreign history of the genus Encrinurus is reviewed.—E. W. **Ferguson**: Revision of the Amycterides. Part iv., Sclerorinus (Section i.) [Coleoptera: Amycteridæ]. The total number of species recognised is sixty-one. Section i. comprises one group of nineteen species, of which two are described as new. This group is strongly represented in South Australia, extending, on the east, into the coastal and mountain districts of Victoria and Tasmania.—R. **Greig-Smith**: Contribu-

tions to a knowledge of soil fertility. No. xiii., The toxicity of soils. The formation of toxins, in a soil free from vegetation, occurs most rapidly when the temperature is near 28°, and the moisture-content is one-fourth of the water-holding capacity. The soil-extract is, as a rule, either nutritive or toxic, according to the volume of water, relative to the soil, used in preparing the extract. It is most nutritive when the ratio of soil to water is 1 : 0·5, and most toxic when it is 1 : 1. A previous drying or chloroforming of the soil causes the extract to be much more nutritive than when the raw soil is used. The addition of small quantities of dextrose to soil brings about a more rapid production of toxin, while aeration of the treated soil accelerates the formation and decay of the toxin.—W. W. **Froggatt**: Notes on a collection of Australian and other Myriapods. Notes on nine species are offered; one of them from the New Hebrides, a second from Queensland and the New Hebrides; the others, including *Scolopendra morsitans*, Linn., from various Australian localities, chiefly in the western portion of New South Wales. *S. morsitans*, originally described from India, and with a wide distribution, is the common centipede of the interior of Australia.—H. W. **Brölemann**: Description of a new Myriapod from New South Wales. A species of Schizoribautia from Brewarrina and Nevertire, N.S.W., is described as new.

BOOKS RECEIVED.

The Scientists' Reference Book and Diary, 1916. (Manchester: J. Woolley, Sons, and Co., Ltd.) 2*s*.

Dinosaurs, with Special Reference to the American Museum Collections. By W. D. Matthew. Pp. 162. (New York: American Museum of Natural History.)

The Marine Biological Station at Port Erin (Isle of Man), being the 29th Annual Report of the Liverpool Marine Biology Committee. Drawn up by Dr. W. A. Herdman. Pp. 57. (Liverpool: C. Tinling and Co., Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. li., part ii. (No. 7). Studies on the Development of the Horse. (1) The Development during the Third Week. By Prof. J. Cossar Ewart. Pp. 287–329+plates ix–xviii. (Edinburgh: R. Grant and Son.) 7*s*.

Hazell's Annual for the Year 1916. Edited by Dr. T. A. Ingram. Pp. 528. (London: Hazell, Watson and Viney, Ltd.) 3*s*. 6*d*. net.

Proceedings of the Yorkshire Geological Society. Vol. xviii. Bibliography of Yorkshire Geology (C. Fox-Strangway's Memorial Volume.) By T. Sheppard. Pp. xxxvi+629. (London and Hull: A. Brown and Sons, Ltd.)

Penrose's Annual. Vol. xxi. The Process Year Book. Edited by W. Gamble. Pp. 112+plates. (Bradford and London: Lund, Humphries and Co., Ltd.) 5*s*. net.

Algebraic Equations. By Dr. G. B. Mathews. Second edition. Pp. 64. (Cambridge: At the University Press.) 2*s*. 6*d*. net.

A First Course of Geometry. By Dr. C. Davison. Pp. 89. (Cambridge: At the University Press.) 1*s*. 6*d*.

Exercises in Practical Physics. By Profs. A. Schuster and C. H. Lees. Fourth edition. Revised. Pp. x+379. (Cambridge: At the University Press.) 7*s*. net.

Archæological Excavation. By J. P. Droop. Pp. x+80. (Cambridge: At the University Press.) 4*s*. net.

Collected Papers on Spectroscopy, with a Supplementary Paper not Heretofore Published, and a Classified Index. By Prof. J. D. Liveing and Sir J. Dewar. Pp. xv+566. (Cambridge: At the University Press.) 30*s*. net.

Euclid's Book on Divisions of Figures, with a Restoration based on Woepcke's Text and on the Practical Geometriæ of Leonardo Pisano. By Prof. R. C. Archibald. Pp. 88. (Cambridge: At the University Press.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 6.

OPTICAL SOCIETY, at 8.—The Use of a Graticule in Binoculars and Telescopes: S. D. Chalmers.

FRIDAY, JANUARY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Discovery and Excavation of a Large Specimen of *Elephas antiquus* near Chatham: Dr. C. W. Andrews.

MONDAY, JANUARY 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Adriatic Slavs and their Relation to the Future Overland Route to Constantinople: Sir A. Evans.

TUESDAY, JANUARY 11.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Electric Locomotive: F. W. Carter.

THURSDAY, JANUARY 13.

ROYAL SOCIETY OF ARTS, at 4.30.—The Romance of Indian Surveys: Sir T. H. Holdich.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Predetermination of the Performance of Dynamo-electric Machinery: Prof. Miles Walker.

MATHEMATICAL SOCIETY, at 5.30.—The Transition from Vapour to Liquid, when the Range of the Molecular Attractions is Sensible: Sir J. Larmor.—(1) A Note on the Uniform Convergence of the Fourier Series $\Sigma a_n \sin n\theta$; (2) A Condition for the Validity of Taylor's Expansion: T. W. Chaundy.

FRIDAY, JANUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 7.—The Operculum of the Genus Bursa (Ranella): Rev. A. H. Cooke.—The Shells of the South African Species of Lepiidæ: E. A. Smith.—(1) A Volume of Plates Prepared for the Second Edition of Pulteney's "Dorsetshire Shells" in Hutchin's "History of Dorset"; (2) Lovell Reeve's "Elements of Conchology," with some Dates of Publication: A. Reynell.

CONTENTS.

Editorial and Publishing Offices:
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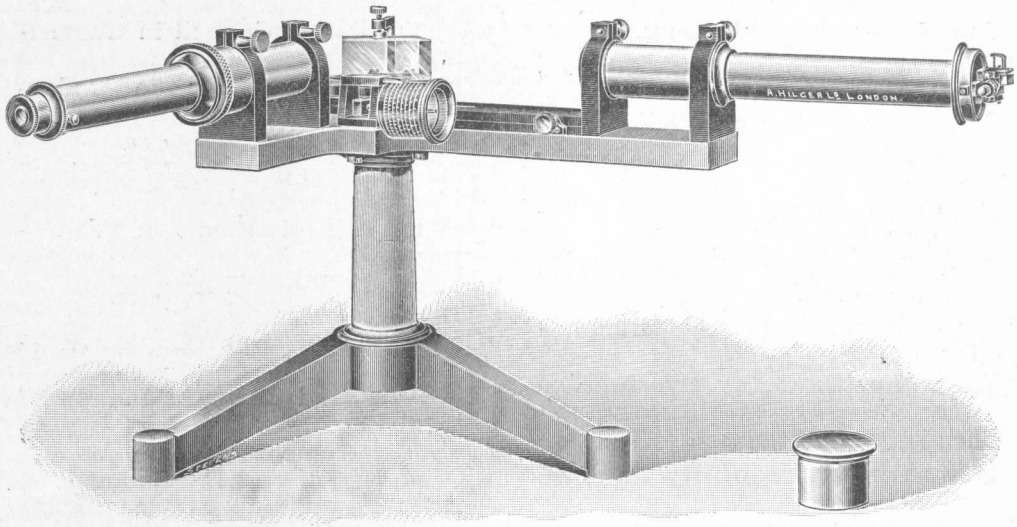

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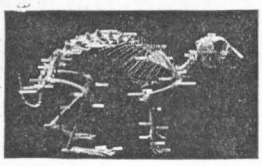

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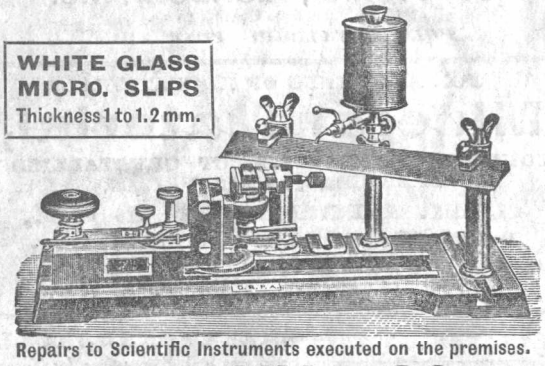

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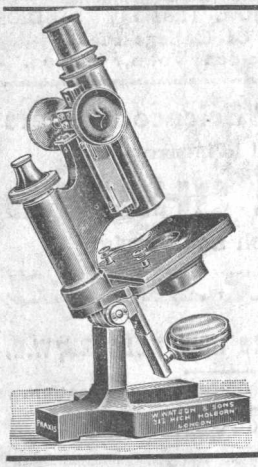

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